Vol. 18, No. 2
February 1993

Energy Research Abstracts

Abstracts 2494–4835

Office of Scientific and Technical Information
UNITED STATES DEPARTMENT OF ENERGY

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Vol. 18, No. 2
February 1993
ISSN: 0160-3604
CODEN: ERABDZ

Energy Research Abstracts

Coverage

Energy Research Abstracts (ERA) provides abstracting and indexing coverage of all scientific and technical reports and patent applications originated by the U.S. Department of Energy, its laboratories, energy centers, and contractors, as well as theses and conference papers and proceedings issued by these organizations in report form. Audiovisual materials, computer media (magnetic tapes, diskettes, etc.), and engineering drawings are included in this definition. *ERA* also covers other energy information prepared *in report form* by federal and state government organizations, foreign governments, and domestic and foreign universities and research organizations, *provided* that the full text of the document has been received by OSTI. Foreign report information is obtained through the International Energy Agency's 14-nation Energy Technology Data Exchange, the International Atomic Energy Agency's International Nuclear Information System, or nation-to-nation agreements. The purpose of this publication is to announce documents produced or obtained by DOE that are not so readily available as journal articles, books, or patents.

Scope

The scope of *ERA* encompasses DOE's research, development, demonstration, and technology programs resulting from its broad charter for energy sources, supplies, safety, environmental impacts, and regulation.

The citations presented in *ERA* are available for online searching as records within the Energy Science and Technology Database (EDB). The current-year records are available on the Integrated Technical Information System (ITIS).

Availability

DOE and DOE contractors who have OSTI deposit accounts can obtain *ERA* (regular issues and annual indexes) from the Office of Scientific and Technical Information, P.O. Box 62, Oak Ridge, TN 37831, Attention: Information Services. For further information, call (615)576-8401. *ERA* is also available at authorized GPO Depository Libraries. (List is provided on the inside back cover.)

ERA (regular issues and annual indexes) is available to the public on a subscription basis from the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402.

Managing Editor, Doris M. Henline
Technical Editor, Milton O. Whitson

Information Sources

The citations presented in *Energy Research Abstracts* are a subset of the worldwide energy information provided to the Office of Scientific and Technical Information (OSTI) through exchange agreements with foreign sources and through exchanges or contracts with U.S. organizations.

The **Energy Technology Data Exchange (ETDE)** was established by the International Energy Agency to promote cooperation among members in conducting appropriate energy-related research and development programs through the development of a formal central information sharing system. In accomplishing the objectives of the ETDE, members select, abstract, and index relevant research information published in their countries in accordance with Exchange standards. OSTI serves as the central receiving and processing center for this information, which it then disseminates to national centers in the participating countries. The following countries are currently members of the ETDE:

- Canada
- Denmark
- Finland
- France
- Federal Republic of Germany
- Italy
- Japan
- The Netherlands
- Norway
- Spain
- Sweden
- Switzerland
- United Kingdom
- United States

The **International Nuclear Information System (INIS)** was established to promote the exchange of information on nuclear science and technology. Its operation is similar to that of the ETDE, with the INIS Secretariat being located in Vienna, Austria. Currently, 79 countries and 15 international organizations are members of INIS. OSTI serves as the INIS national center for the United States.

In the exercise of its rights and responsibilities under the agreements to which it is a party, the **Office of Scientific and Technical Information** both receives information from the above sources and submits U.S.-produced information to them. In addition to materials generated by the Department of Energy, this U.S.-produced information is gathered from other government agencies as well as under contract with private information processing companies. All input is computer processed and entered into a database for online retrieval. The database serves as well for the production of numerous OSTI publications.

How To Read A Citation

The principal data elements included in these citations are:

1. **Abstract number** within volume.
2. **Report number** identification for report-type literature.
3. **Title and subtitle** (non-English title may appear in parentheses, if applicable).
4. **Author(s).** First 10 names in the data record are printed, then "et al." is listed.
5. **Author affiliation.** Only first one is listed, in parentheses after author(s) to which it applies.
6. **Collaboration,** if present.
7. **Corporate author(s)** identifying corporation responsible for document.
8. **Date of publication.** If not known, a processing date is in brackets.
9. **Number of pages** or page range. Prices are based on total pages unless special pricing applies.
10. **Language** of document if non-English.
11. **Monograph title** if citation is an analytic (part, chapter, or paper) of a larger monograph.
12. **Sponsoring organization.**
13. **Contract or grant number.**
14. **Secondary identifying number;** may be a conference number.
15. **Conference title, location, and date,** if applicable.
16. **Order number.** The "DE" order number may be used for ordering from NTIS or OSTI, as appropriate. The "TI" prefix is valid only at OSTI.
17. **Sources of availability** from which a copy of the document may be obtained; usually appear as abbreviations. (See information on following page.)
18. **Drop note** or explanatory statement.
19. **Abstract.**
20. **Subject descriptors.** Listed only if no abstract or only a brief statement is included.

Sample Citations

Report

18494 (DOE/ER/40438–T1) **[Development of a hydrogen and deuterium polarized gas target for application in storage rings]: Progress report.** Haeberli, W. Phys. VI collaboration. Wisconsin Univ., Madison (USA). Dept. of Physics. [1989]. 12p. Sponsored by DOE Energy Research. DOE Contract FG02-88ER40438. Order Number DE89007246. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

This paper briefly discusses the Wisconsin test facility for storage cells; results of target tests; the new UHV...

Report Analytic

18500 (INIS-SU—69, pp. 30-32) **Transition energies in Ne-like ions. Correlation effects.** Vainshtejn, L.A. AN SSSR, Moscow. Fizicheskij Inst. 1988. (In Russian). In *Experimental and theoretical physics. Collection.* Order Number DE89780060. Available from NTIS (US Sales Only), PC A03/MF A01; INIS.

Kratkie Soobshcheniya po Fizike.; no. 6.

SILVER IONS/energy-level transitions; XENON IONS/energy-level transitions; CORRELATIONS; D STATES; E STATES;...

54 (DOE/ER/60888-1-Vol.1, pp. 115-117) **Investigation of air pollution in house due to use of various fuels.** Luo, Dayu (Chengdu Sanitation (China)). Canada Mortgage and Housing Corp., Ottawa, ON (Canada). 1990. (CONF-900724-Vol.1: Indoor Air '90: 5th international conference on indoor air quality and climate, Toronto (Canada), 29 Jul - 3 aug 1990). In Indoor air '90: The fifth international conference on indoor air quality and climate. Volume 1: Final report. 786p. Order Number DE90017786. Source: NTIS.

Air pollution in houses caused by combustion of coal is more serious than that by combustion of natural gas and methane (primarily by SO_2 and NO_2). The gas concentration after cooking is higher than that before cooking, and it is higher in kitchen than in bedroom and outdoor. There were mutations in the extract from TSP in 30m^2 air in the bedroom, kitchen and outdoor, where coal and natural gas were used. The supernatant saliva activity of children whose family uses coal is significantly lower than that of pumping streams.

How To Order from the Availability Sources

TO OBTAIN A REPORT

Report literature, usually identified by an alphanumeric identifier at the beginning of a citation, is available from the sources listed in the citation (see example of element 2 on page iii). Often the sources are listed as abbreviations. Corresponding addresses are provided at right from which documents with these abbreviations may be ordered. When "OSTI" is given, **DOE and DOE contractors may order these documents from OSTI.** (However, check with your library or information organization which may require that orders go through them to OSTI.) OSTI prices are based on total pages unless special pricing applies. The public should order from NTIS or from one of the other agencies listed in the citation. NTIS price codes may continue to appear in some records. To expedite processing, an order form is provided in the back of this publication. NOTE: The order numbers provide quicker access for report ordering. Use the order number where possible.

GPO	Superintendent of Documents Government Printing Office Washington, DC 20402
GPO Dep.	Available for inspection or interlibrary loan at Government Printing Office regional depository libraries.
INIS	*Available only in microfiche.* INIS Clearinghouse International Atomic Energy Agency P.O. Box 100, A-1400 Vienna, Austria
NTIS	U.S. Department of Commerce National Technical Information Service 5285 Port Royal Road Springfield, VA 22161
OSTI	U.S. Department of Energy Office of Scientific and Technical Information P.O. Box 62 Oak Ridge, TN 37831
ESTSC	Energy Science and Technology Software Center P.O. Box 1020 Oak Ridge, TN 37831

How To Use the Indexes

Five indexes are provided for approaching the content of each issue of *Energy Research Abstracts.* Descriptions of entries in these indexes follow.

Corporate Author Index
The corporation, organization, or institution responsible for the issuance of the document is listed in this index. The entries are arranged alphabetically and provide the title and citation number of the reference. For example, the listing for the "Report" sample citation would appear as shown at right.

Wisconsin Univ., Madison (USA). Dept. of Physics
[Development of a hydrogen and deuterium polarized gas target for application in storage rings]: Progress report, 15:18494 (R;US)
Wisconsin Univ., Madison (USA). Lab. of Genetics
Organization of the R chromosome region in maize: Final progress report, June 1, 1983–May 31, 1986, 15:18255 (R;US)

Personal Author Index
Each author's name listed on a document cited in this issue is indexed. An index entry provides title and citation number; for secondary and other names, a cross-reference is given to the primary author name where the full index entry is located.

Hadley, D.L., *See* Lee, A.D., 15:17651
Haeberli, W., [Development of a hydrogen and deuterium polarized gas target for application in storage rings]: Progress report, 15:18494 (R;US)

Subject Index
This index lists the main subject descriptors assigned to each record by indexing professionals. A secondary or qualifier term is used where necessary to describe materials, objects, and processes. Document titles may be enhanced with additional informative phrases where necessary. An excerpt from this index appears at right.

HYDROGEN ISOTOPES
See also DEUTERIUM
HYDROGEN 4
TRITIUM
Neutron-Rich Isotopes
Study on the strong neutron-rich nuclei of lightest elements, 15:18686 (RA;SU;In Russian)

Contract Number Index
DOE technical reports are listed by contract number. Each entry also provides the primary corporation or organization cited for that contract number. A typical entry is shown.

FG02-88ER40438 **Wisconsin Univ., Madison (USA). Dept. of Physics**
15:18494 DOE/ER/40438–T1
FG02-88ER60664 **Rogers and Associates Engineering Corp., Salt Lake City, UT (USA)**

Report Number Index
Technical report literature is indexed by the alphanumerical identifier of the report. Patent documents and conferences are included for convenience. Each entry lists the citation number, the source of availability of the document, an indicator of presence at a GPO depository library, order number, and distribution category. A typical entry is:

DOE/ER/40438–T1 15:18494 NTIS, OSTI E 1.99: DE89007246 MF-411

Subject Contents

The subject content of *Energy Research Abstracts* is arranged as shown below. The two-digit and four-digit category numbers printed here illustrate the category number assignment used in the database records.* The following list includes all of the 38 first-level and the 313 second-level categories. Because each issue of *ERA* publishes citations only for those documents announced during the past semimonthly period, some subject categories may not be present in every issue.

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*The numerical subject category scheme is used in the storage, retrieval, and manipulation of bibliographic information entered into DOE's data systems. Categories and definitions for the complete set of six-digit numbers are given in ETDE/PUB--1-R2, *International Energy: Subject Categories and Scope*.

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Energy Research Abstracts

01 COAL, LIGNITE, AND PEAT

2494 (DOE/PC–93000364) **PETC Review, Issue 6, Summer 1992.** Santore, R.R.; Blaustein, B.D.; Reiss, J.; Brown, J. (eds.). USDOE Pittsburgh Energy Technology Center, PA (United States). [1992]. 56p. Sponsored by USDOE, Washington, DC (United States). Order Number DE93000364. Source: OSTI; NTIS; INIS; GPO Dep.

This issue of the PETC Review focuses on the Clean Coal Technology Demonstration Program. Several projects were completed recently and many more are beginning to generate data from operations, making this an ideal time to highlight this program. The program, which was initiated in 1986, now has 42 projects that represent a remarkable scope of activities ranging from the demonstration of improved retrofit components to the repowering of coal-fired electrical power plants with advanced systems. In 1986, when Congress committed the nation to this multi-billion dollar, multi-year demonstration program, the policy goals were clearly set forth and the funding was completely committed. I believe that defining and sticking to these goals and commitments has been critical to establishing substantial industry interest and investment, thereby enhancing the prospects for success. Both the public and private sectors were better able to establish priorities and to allocate resources to projects that best meet our nation's energy and environmental needs. I believe that the Clean Coal Technology program will help fulfill the goals for coal that were recently reaffirmed in the National Energy Strategy: One Year Later-to maintain coal's competitiveness and to create a favorable export market for US coal and coal technology.

0103 Preparation

Refer also to citation(s) 2519, 2546

2495 (DOE/PC/79887–T18) **Extraction, separation, and analysis of high sulfur coal: Final report.** Olesik, S.V.; Pekay, L.A.; Larkins, W. Jr. (comps.). Ohio State Univ., Columbus, OH (United States). Dept. of Chemistry. 31 May 1992. 105p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC22-87PC79887. Order Number DE93003192. Source: OSTI; NTIS; GPO Dep.

The work described in this report studies the removal of sulfur by oxidative interaction of various cupric salts with coal and also considers the possibility of removing organic sulfur by the selective interaction of supercritical ethanol with the organic coal matrix. Either one of these methods could potentially be used to pretreat coals before burning. The primary purpose of these studies is to ascertain the nature of the chemical reactions occurring, the chemical composition of the resultant products, and information on possible reaction mechanisms. This information should allow prediction of reasonable reaction conditions for the removal of organosulfur compound from coal.

2496 (DOE/PC/90311–8) **Characterization of multiphase fluid flow during air-sparged hydrocyclone flotation by x-ray CT: Eighth quarterly report, 14 May 1992–13 August 1992.** Miller, J.D. Utah Univ., Salt Lake City, UT (United States). 17 Aug 1992. 5p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG22-90PC90311. Order Number DE93000920. Source: OSTI; NTIS; GPO Dep.

The effect of A* (the dimensionless ratio of overflow opening area to underflow opening area) on the fluid flow behavior of the 2 inch ASH-2C unit was studied for different percentage of solids in the suspension. Limestone, a hydrophilic solid was chosen for study. The particle size of the solids was taken as −100 +200 mesh. Three different concentrations of solids in the suspension were considered, 5, 10 and 20% by weight. The corresponding pulp densities of the feed suspension for these three cases are 1.09, 1.18 and 1.36 g/cc respectively. Since no collector was added to the suspension, all the solids are expected to report to the underflow. For all these studies the Q* value was maintained at the same level (Q* = 2.28). Reconstructed images from the CT scanner were analyzed using the graphics software developed at the University of Utah. Assuming the air core to be cylindrical in shape and using the previously generated calibration curve, the average density of the swirl layer and its average thickness were estimated for each slice. These results are presented graphically in the accompanying figures along the axis of the ASH unit from bottom to top.

2497 (DOE/PC/91334–T93) **Integrated production/use of ultra low-ash coal, premium liquids and clean char: Technical report, March 1, 1992–May 31, 1992.** Kruse, C.W. (Illinois State Geological Survey, Champaign, IL (United States)); Carlson, S.L.; Snoeyink, V.L.; Feizoulof, C.; Assanis, D.N.; Syrimis, M.; Fatemi, S.M. Illinois Dept. of Energy and Natural Resources, Springfield, IL (United States). [1992]. 29p. Sponsored by USDOE, Washington, DC (United States); Illinois Dept. of Energy and Natural Resources, Springfield, IL (United States). DOE Contract FG22-91PC91334. Order Number DE93000950. Source: OSTI; NTIS; GPO Dep.

The first step in the envisioned integrated, multi-product approach for utilizing Illinois coal is the production of ultra low-ash coal. Subsequent steps would convert low-ash coal to high-value products through mild gasification, char activation, and oxidation reactions. Approximately eight pounds of low-ash coal has been obtained from the crude reactor slurry produced for us at the University of North Dakota Energy and Environmental Research Center (UNDEERC). After treatment to remove the remaining meta-cresol, this material will be subjected to mild gasification. Low-ash mild gasification char will be activated and a catalyst surface will be added by oxidation. A 20% coal: 80% diesel fuel slurry was tested in cylinder two of a two-cylinder, diesel engine after the necessary modifications in the engine's fuel injection system were made. Four tests indicated that the coal successfully substitutes for diesel fuel in the slurry. The fuel burns in the cylinder, with slightly improved thermal and combustion efficiency. The tests were performed at 1800 rpm and 2200 rpm and 75% load. The change in the surface properties of Calgon F-400 commercial activated carbon caused by several treatments were examined by X-ray Photoelectron Spectroscopy (XPS).

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Refer also to citation(s) 2495, 2497, 2561, 2563, 2564, 2565, 2567, 2574, 2592, 2594, 2961, 2962, 2963, 3672, 4385

2498 (CONF-910550–, pp. 767-776) **Interactions of thiophenes and acidophilic, thermophilic bacteria.** Constanti, M. (Univ. of Barcelona (Spain)); Giralt, J.; Bordons, A.; Norris, P.R. National Renewable Energy Lab., Golden, CO (United States); Oak Ridge National Lab., TN (United States). 1992. From 13. symposium on biotechnology for fuels and chemicals; Colorado Springs, CO (United States); 6-10 May 1991. In *Thirteenth symposium on biotechnology for fuels and chemicals: Proceedings.* 846p. Source: The Humana Press, Inc., Totowa, NJ 07511 (United States).

The growth and oxygen consumption of a variety of thermophilic, acidophilic bacteria in the presence of thiophene-2-carboxylate (T2C) and dibenzothiophene (DBT) have been determined. T2C was extremely toxic to the acidophiles in comparison with neutrophiles, but appeared to be degraded by a heterotrophic Sulfolobus-like thermophile. DBT proved to be unstable at high temperatures, even in the absence of bacteria, and was not a substrate for the thermophiles.

2499 (DOE/FE/60848–T1) **Test summary and detailed test plan for Mild Gasification Process Unit: Final report.** Sheladia Associates, Inc., Rockville, MD (United States). [1992]. 17p. Sponsored by USDOE, Washington, DC (United States). DOE Contract

AC01-85FE60848. Order Number DE93002850. Source: OSTI; NTIS; GPO Dep.

The objectives of this task are: (1) to shake down the DOE's Mild Gasification Process Unit (PU) constructed in Task 4, and (2) to perform tests to determine the effect of operating conditions (temperature, residence time, particle size, sweep gas, solid additive, and feedstock) on the unit operability and products quality, quantity and characteristics. Figure 1 depicts the reactor and salient features of the Mild Gasification process. Sized coal is transferred from a coal hopper to the volumetric coal bins by a flexible screw conveyor. The coal bins are vacuum sealed after they are filled to a predetermined level. Coal is then fed, by gravity, to the reactor tubes where it undergoes devolatilization for 3 to 5 hours. Reactor tubes are designed to operate at atmospheric pressures and temperatures of up to 1300°F. The evolved gases from each reactor is led through a gas exit pipe to a condenser system. Each condenser system includes four water cooled condensers which separate the liquid products into four fractions. The condensate from each condenser is collected intermittently in a product pot. The non-condensable gases leaving the condenser systems are then combined, passed through provides a small negative pressure which facilitate withdrawal of evolved gases from the reactor tubes. Provisions are also made for addition of sweep gases to the reactors. Twenty four tests are planned to determine the effects of feedstock, temperature, solid residence time, particle size, solid additive, and sweep gas.

2500 (DOE/MC/25020–3128) **Screening of processing and upgrading schemes: Task 3.** Lummus Crest, Inc., Bloomfield, NJ (United States). Oct 1991. 260p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC21-88MC25020. Order Number DE93000213. Source: OSTI; NTIS; GPO Dep.

The RFP was predicated on DOE's desire to enhance the development of advanced transportation fuels made from coal via a program to process mild coal gasification (MCG) liquids into high volumetric energy density (HEDF) test fuels. The desired product fuels were to be cost effectively manufactured, have high volumetric energy density, and be hydrocarbon-based for existing and prototype turbine and diesel engines. The sources for these special fuels consist of the abundant and secure indigenous energy resources of coal. Comparison studies were also to be made using other non-petroleum fossil fuels such as shale oil and tar sands bitumen. METC has concluded that MCG technology has the potential to simultaneously satisfy the transportation and power generation fuel needs in the most cost-effective manner. MCG is based on low temperature pyrolysis, a technique known to the coal community for over a century. Most past pyrolysis developments were aimed at maximizing the liquids yield which results in a low quality tarry product requiring significant and capital intensive upgrading. By properly tailoring the pyrolysis severity to control the liquid yield-liquid quality relationship, it has been found that a higher quality distillate-boiling liquid can be readily "skimmed" from the coal. The resultant liquids have a much higher H/C ratio than conventional pyrolytic tars and therefore can be hydroprocessed at lower cost. These liquids are also extremely enriched in 1-, 2-, and 3-ring aromatics.

2501 (DOE/METC/C–93/7033) **Trace contaminants in fixed-bed gasifier gas.** Grindley, T.; Gardner, T.H. Department of Energy, Morgantown, WV (United States). Morgantown Energy Technology Center. [1992]. 32p. Sponsored by USDOE, Washington, DC (United States). (CONF-920951–5: US Department of Energy contractors review meeting on gasification and gas stream cleanup systems, Morgantown, WV (United States), 15-17 Sep 1992). Order Number DE93001384. Source: OSTI; NTIS; GPO Dep.

A high-temperature, fixed-bed zinc ferrite, sidestream desulfurization unit has been utilized to study the desulfurization of hot gas from the METC 42-inch diameter, fixed-bed gasifier. Early investigations in 1983 (Grindley 1984) were during gasifier runs 101 to 104 and were concerned primarily with establishing tho performance of regenerable desulfurization sorbents. In 1986 the sidestream unit was again operated during gasifier runs 105 through 107 and more detailed gas stream characterization was obtained. The purpose of this paper is to present the results of gas stream analyses sampled at the outlet of the gasifier and the inlet and outlet of the desulfurizer. The analyses were achieved by filtering particles from the hot gas and condensing water and tars from the filtered and unfiltered gases. Particles, condensates, and gases were analyzed for sulfurous and nitrogenous compounds, halogens, trace metals, and various ionic species. The purpose for obtaining a detailed gas stream characterization is to aid in the study and design of hot gas purification concepts.

2502 (DOE/PC/70023–T3) **Micelle-derived catalysts for extended Schulz-Flory: Technical progress report, January 1, 1985–March 31, 1985.** UOP, Inc., Des Plaines, IL (United States). Signal UOP Research Center. [1985]. 44p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC22-84PC70023. Order Number DE93003291. Source: OSTI; NTIS; GPO Dep.

The reduced C-73-1-101 iron catalyst was retested in Run 10, under the third set of reference conditions: 208°C, 500 psig, 0.9 (molar) H_2/CO feed ratio, ~ 35% initial CO conversion. The analysis of the products collected during the entire 252-hour run, including the wax recovered from the catalyst, resulted in $\alpha = 0.78$ for carbon numbers 1 to 15 and $\alpha = 0.88$ for carbon numbers 16 to 45. The results of Run 10 are satisfactory and will be used in the future as reference performance. No further tests with the reference catalyst are going to be conducted until a method for testing experimental catalysts is established and new reference performance under different conditions is necessitated. Ruthenium particles, mostly in the 40 to 60 Å size range, were prepared on the γ-alumina by using a micelle technique. The narrow size distribution of ruthenium particles was not maintained and some very large particles up to 1000 Å resulted when the catalyst preparation was upscaled from 2 g to ~ 30 g. The causes of the maldistribution that occurred during the scaling up of the catalyst preparation are under investigation. The catalyst which showed broad size distribution of ruthenium particles showed rapid deactivation during a test in Plant 700. Investigations are under way to improve the catalytic stability. Small angle X-ray scattering was used to characterize the reversed micelle solution used in the preparation of ruthenium catalysts. The volume averaged diameter of the water core for the reversed micelles is between 75 and 90 Å.

2503 (DOE/PC/70023–T4) **Micelle-derived catalysts for extended Schulz-Flory: Technical progress report, April 1, 1985–June 30, 1985.** UOP, Inc., Des Plaines, IL (United States). Signal UOP Research Center. [1985]. 46p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC22-84PC70023. Order Number DE93003293. Source: OSTI; NTIS; GPO Dep.

A micelle procedure was established for preparing, in 30 g quantity, catalysts with ruthenium crystallites of specific size. A catalysts (4956-76) prepared by the micelle procedure and having 40–60 Å ruthenium crystallites, according to the scanning transmission electron microscope (STEM) analysis, was tested in the Fischer-Tropsch fixed-bed pilot plant and showed significantly improved stability over catalysts for which the micelle technique has not been successfully applied. A hydrocarbon cut-off number was not observed, in the C_1-C_{180} carbon number range, with Catalyst 4956-76 containing 40–60 Å ruthenium crystallites. Catalyst 4956-76 was reexamined with STEM after 248 hours of testing and did not display any noticeable change in the ruthenium crystallite size. Two new catalysts (4956-95 and 4956-97) were prepared with ruthenium crystallites of smaller size by the micelle procedure. Reverse micelle solutions with reverse micelles of smaller size were used for preparing these catalysts. Catalyst 4956497, with mostly 20–30 Å ruthenium crystallites, is going to be evaluated to Determine the effect of ruthenium crystallite size on selectivity. X-ray diffraction (XRD) measurements were conducted on two ruthenium catalysts (1.1 and 1.7% Ru, by weight) prepared by a micelle technique, in order to confirm the narrow size distribution of ruthenium crystallites detected in the STEM examination. It was concluded that the XRD technique cannot be utilized to measure crystallite size distribution of (1–2 wt.% Ru) ruthenium on γ-alumina because of the interference of the strong signal from the alumina support.

2504 (DOE/PC/70023–T6) **Micelle-derived catalysts for extended Schulz-Flory: Technical progress report, October 1, 1985–12/31/85.** Abrevaya, H. UOP, Inc., Des Plaines, IL (United States). Signal UOP Research Center. [1985]. 5p. Sponsored by

USDOE, Washington, DC (United States). DOE Contract AC22-84PC70023. Order Number DE93003295. Source: OSTI; NTIS; GPO Dep.

Our objective is to develop a catalyst for making gasoline or diesel range fuel selectively from synthesis gas. Our catalyst development approach is to provide a cut-off for the higher end of the hydrocarbon distribution by limiting the size of the active metal particle. We are using a micelle technique for preparing specific size ruthenium particles supported on γ-alumina. Hydrocarbon cut-off was not observed with 40–60 Å ruthenium particles on γ-alumina. We could not determine whether smaller ruthenium particles would provide cut-off since they agglomerated during the test, apparently through the formation of ruthenium carbonyl. In order to determine whether ruthenium migration can be eliminated under a new set of testing conditions, we evaluated the effect of H_2:CO feed gas ratio and the effect of total pressure on ruthenium migration. Ruthenium migration was significantly suppressed but not totally eliminated by increasing the H_2:CO feed gas ratio from 0.9 to 3.0. At the same H_2:CO feed gas ratio, lowering the total pressure from 500 psig to 150 psig enhanced ruthenium migration. During the next quarter, the use of high pressure in conjunction with high H_2:CO feed gas ratio will be evaluated to eliminate ruthenium migration. In case agglomeration of small ruthenium particles cannot be totally eliminated, products initially obtained during a test will be carefully examined to determine whether cut-off occurs prior to ruthenium agglomeration.

2505 (DOE/PC/70023–T7) **Micelle-derived catalysts for extended Schulz-Flory: [Quarterly report], January 1, 1986–March 31, 1986.** Abrevaya, H. Signal Research Center, Inc., Des Plaines, IL (United States). [1986]. 4p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC22-84PC70023. Order Number DE93003296. Source: OSTI; NTIS; GPO Dep.

The objective of this program is to develop a synthesis gas conversion catalyst selective to gasoline or diesel range fuel via application of a micelle technique for preparing specific site supported ruthenium particles. The current emphasis is to investigate hydrocarbon cutoff principle and to apply it for developing selective catalysts. During this quarter, micelle technique was further improved and 1 ruthenium particle:l reverse micelle limit was approached by careful control of catalyst synthesis conditions. Accordingly, it became possible to synthesize supported particles that closely meet the size and composition targets originally set. This improved technique was applied to synthesis of chemically modified ruthenium catalysts. Some of the chemically modified ruthenium catalysts will be evaluated later in the program. We previously reported that 40–60 Å ruthenium particles prepared on γ-alumina do not result in hydrocarbon cutoff. We could not determine then whether smaller ruthenium particles result in hydrocarbon cutoff because these particles agglomerated via ruthenium carbonyl formation during the course of a 6–10 day test. We have recently evaluated a catalyst with 20–40 Å ruthenium particles prepared on γ-alumina by carefully analyzing products initially made during the test prior to substantial ruthenium agglomeration. We concluded that cutoff is not effected by 20–40 Å ruthenium particles prepared on γ-alumina. In the future, we are going to investigate the occurrence of cutoff principle with <20 Å ruthenium particles prepared on γ-alumina. We are also going to attempt to determine whether some of the literature reports of hydrocarbon cutoff with small ruthenium particles can be attributed to the chain length selective nature of zeolitic supports that were used in those experiments.

2506 (DOE/PC/70023–T8) **Micelle-derived catalysts for extended Schulz-Flory: [Quarterly report], April 1, 1986–June 30, 1986.** Abrevaya, H. Signal Research Center, Inc., Des Plaines, IL (United States). [1986]. 3p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC22-84PC70023. Order Number DE93003297. Source: OSTI; NTIS; GPO Dep.

The objective of this program is to develop a synthesis gas conversion catalyst with improved selectivity to gasoline or diesel range fuel via application of a micelle technique for preparing novel supported catalysts with specific size ruthenium particles. The major emphasis is to investigate hydrocarbon cutoff principle and to apply it for developing selective catalysts. We previously reported that cutoff is not effected with 40–60 Å and 20–40 Å ruthenium particles on γ-Al_2O_3. We recently tested a catalyst with <20 Å ruthenium particles. Well dispersed ruthenium in that catalyst extensively agglomerated to larger particles even during the course of a short test despite the high H_2:CO ratio used. Therefore, we could not conclude whether cutoff is effected with <20 Å ruthenium particles. We are going to continue to evaluate the effect of operational conditions and also evaluate the effect of modifiers on ruthenium agglomeration. A catalyst with <20 Å ruthenium particles will be evaluated to investigate occurrence of cutoff, after no agglomeration conditions are identified. We are now proposing to conduct, parallel to the main approach, a second research approach which will aim at developing a ruthenium catalyst with substantially lower light ends selectivity while maintaining at least similar activity and stability relative to state-of-the-art precipitated iron catalysts. Under this approach, preliminary experiments indicated that a catalyst (1.12 wt.% Ru or γ-Al_2O_3) with 30–70 Å ruthenium particles shows initially ~10% lower carbon atom-selectivity to light ends (C_1–C_4) and is approximately 4X less active relative to precipitated iron catalyst used in the Sarol Arge reactor.

2507 (DOE/PC/70023–T9) **Micelle-derived catalysts for extended Schulz-Flory: Technical progress report, July 1, 1986–September 30, 1986.** Abrevaya, H. Signal Research Center, Inc., Des Plaines, IL (United States). [1986]. 3p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC22-84PC70023. Order Number DE93003298. Source: OSTI; NTIS; GPO Dep.

The objective of this program is to develop a synthesis gas conversion catalyst with higher selectivity to liquid fuels, while maintaining catalytic activity and stability at least equivalent relative to state-of-the-art precipitated iron catalysts. During this quarter, the emphasis in the program has been the investigation of the hydrocarbon cutoff hypothesis with supported ruthenium catalysts. An alumina-supported catalyst with smaller than 20Å ruthenium particles was tested under conditions of maximal water gas shift activity. During this test more than 90% of the water made in the Fischer-Tropsch synthesis reaction was converted to H_2. However, the extent of ruthenium metal agglomeration was not reduced. Accordingly, it was not possible to conclude whether hydrocarbon cutoff occurs with smaller than 20Å ruthenium particles on γ-alumina. A ruthenium catalyst prepared on Y-type zeolite had 20Å or smaller ruthenium particles according to STEM examination and a 15Å average ruthenium metal particle size according to EXAFS examination. The ruthenium metal particle size was stable during the test with this catalyst. The hydrocarbon product distribution was Anderson-Schulz-Flory with no cutoff up to a carbon number of 160. A well-dispersed titania-supported ruthenium catalyst is going to be evaluated during the next quarter in order to determine whether hydrocarbon cutoff occurs.

2508 (DOE/PC/70023–T10) **Micelle-derived catalysts for extended Schulz-Flory: Technical progress report, October 1, 1986–December 31, 1986.** Abrevaya, H. Signal Research Center, Inc., Des Plaines, IL (United States). [1986]. 3p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC22-84PC70023. Order Number DE93003299. Source: OSTI; NTIS; GPO Dep.

The objective of this program is to develop a synthesis gas conversion catalyst with higher selectivity to liquid fuels, while maintaining catalytic activity and stability at least equivalent relative to state-of-the-art precipitated iron catalysts. Hydrocarbon cutoff hypothesis and developmental needs for a ruthenium catalyst with low light ends selectivity were investigated during this quarter. Hydrocarbon product distribution was Anderson-Schulz-Flory up to a carbon number of 250 and cutoff did not occur with a titania-supported catalyst containing ruthenium particles smaller than 20Å. It was found that an alumina-supported catalyst with 1% (by weight) ruthenium in the form of 50Å to 100Å metal particles was initially about half as active (by catalyst volume) and made one quarter of the amount of C_1-C_4 light end products relative to the Sasol precipitated iron catalyst.

2509 (DOE/PC/70023–T11) **The development of a selective ruthenium catalyst: Technical progress report, October 1, 1987–December 31, 1987.** Abrevaya, H. UOP, Inc., Des Plaines, IL (United States). Technical Center. [1987]. 13p. Sponsored by

USDOE, Washington, DC (United States). DOE Contract AC22-84PC70023. Order Number DE93003300. Source: OSTI; NTIS; GPO Dep.

A micelle technique was developed for preparing supported catalysts with different size ruthenium particles. Ruthenium was stabilized on the support, light ends make was minimized and activity was maximized by adjusting the ruthenium particle size and the metal-support interaction. The most promising catalysts consisted of 10–15 nm ruthenium particles on an alumina-titania support and 4–6 nm ruthenium particles on an alumina support. Stability improvement was determined to be the major catalyst developmental need. Work during the next quarter will focus on the development of a stable ruthenium catalyst.

2510 (DOE/PC/70023–T12) **The development of a selective ruthenium catalyst: Technical progress report, January 1, 1988–March 31, 1988.** Abrevaya, H. UOP, Inc., Des Plaines, IL (United States). Technical Center. [1988]. 20p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC22-84PC70023. Order Number DE93003301. Source: OSTI; NTIS; GPO Dep.

A new ruthenium modifier has been identified which improves the catalyst's stability. The modified catalyst with 2.8% Ru achieved 80% conversion at 150 gas hourly space velocity and is expected to have at least 1 year catalyst life with no more tan 6.6% C_1-C_4 selectivity. Activity increase is identified to be the future catalyst developmental need. Work during the next quarter will focus on writing the final report for the program.

2511 (DOE/PC/88818–15) **Two-stage, close coupled catalytic liquefaction of coal: Fifteenth quarterly report, 1 April 1992–30 June 1992.** Comolli, A.G.; Johanson, E.S.; Lee, T.L.K.; Popper, G.A.; Stalzer, R.H. Hydrocarbon Research, Inc., Princeton, NJ (United States). Aug 1992. 14p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC22-88PC88818. Order Number DE93004924. Source: OSTI; NTIS; GPO Dep.

This quarterly report covers activities of the Two-Stage, Close-Coupled Catalytic Liquefaction of Coal program during the period April 1, June 30, 1992, at Hydrocarbon Research, Inc. in Lawrenceville and Princeton, New Jersey. This DOE contract period is from October 1, 1988 to December 31, 1992. The overall purpose of the program is to achieve higher yields of better quality transportation and turbine fuels and to lower the capital and production costs in order to make the products from direct coal liquefaction competitive with other fossil fuel products. The quarterly report covers work on Laboratory Testing, Bench Scale Studies and PDU Activities focusing on scale-up of the CTSL processing of sub-bituminous Black Thunder Coal.

2512 (DOE/PC/88933–3) **Alkali/TX_2 catalysts for CO/H_2 conversion to C_1-C_4 alcohols: Technical progress report, March 1989–August 1989.** Klier, K.; Herman, R.G.; Bastian, R.D.; Flanagan, K.L. Lehigh Univ., Bethlehem, PA (United States). [1989]. 19p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG22-88PC88933. Order Number DE93003538. Source: OSTI; NTIS; GPO Dep.

Ruthenium disulfide catalysts have been synthesized, tested, and characterized during this period of research. It was observed that both the undoped and Cs-doped RuS_2 catalysts produced alcohols and lower amounts of hydrocarbons from H_2/CO = 1.0 synthesis gas at temperatures above 300°C. Calcination and catalytic testing resulted in partial reduction of the RuS_2 to Ru°. Calcination under H_2S prevented the partial reduction of the RuS_2 catalyst, but subsequent catalytic testing again resulted in the formation of a quantity of Ru°. A Cs-doped RuS_2 catalyst was prepared, but it might have had too high of a loading of Cs. Upon testing, a lower activity was observed for the doped catalyst compared with the undoped catalyst, but the alcohol selectivity was the same for the two catalysts.

2513 (DOE/PC/88933–T1) **Alkali/TX_2 catalysts for CO/H_2 conversion to C_1-C_4 alcohols: Technical progress report, December 1989–February 1990.** Klier, K.; Herman, R.G.; Richards, M.; Bastian, R.D. Lehigh Univ., Bethlehem, PA (United States). [1990]. 13p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG22-88PC88933. Order Number DE93003539. Source: OSTI; NTIS; GPO Dep.

The objective of this research is to investigate and develop novel catalysts for the conversion of coal-derived synthesis gas into C_1-C_4 alcohols by a highly selective process. Therefore, the variations of catalyst activity and selectivity for the synthesis of alcohols from $H_2/CO \leq 1$ synthesis gas for a series of A/TX_2 compounds, where A is a surface alkali dopant, T is a transition metal, and X is a S, Se, or Te, will be determined. The alkali component A, which is essential for C-O and C-C bond forming reactions leading to alcohols, will be highly dispersed on the TX_2 surfaces by using chemical vapor deposition (CVD) and chemical complexation/anchoring (CCA) methods. The target alcohol space time yields are of the order of 1 kg of alcohol product per kg of catalyst per hour and the target selectivity is > 90% to alcohols. Among the A/TX_2 compounds initially investigated, preference will be given to A = Cs, T = Group VB element (V, Nb, Ta), and X = S or Se. So delimited A/TX_2 catalysts possess the strongest base (Cs), and the CCA preparation method using crown ethers is expected not only to disperse the alkali ions atomically but also to enhance the basicity of their counterions, thus further increasing the specific rates of the base-catalyzed C-O and C-C bond forming reactions.

2514 (DOE/PC/89658–T3) **Innovative coke oven gas cleaning system for retrofit applications: Quarterly environmental monitoring report No. 3, January 1, 1991–December 31, 1991.** Bethlehem Steel Corp., PA (United States). 16 Oct 1992. 20p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FC22-90PC89658. Order Number DE93004944. Source: OSTI; NTIS; GPO Dep.

Bethlehem Steel Corporation (BSC), in conjunction with the Department of Energy (DOE) is conducting a Clean Coal Technology (CCT) project at its Sparrows Point, Maryland Coke Oven Plant. This project combines several existing technologies into an integrated system for removing impurities from Coke Oven Gas (COG) to make it an acceptable fuel. DOE is providing cost-sharing under a Cooperative Agreement with BSC. This Cooperative Agreement requires BSC to develop and conduct an Environmental Monitoring Plan (EMP) for the Clean Coal Technology project and to report the status of the EMP on a quarterly basis. This report is the third quarterly status report of the EMP. It covers the Environmental Monitoring Plan activities for the full year of 1991 from January 1, 1991 through December 31, 1991, including the forth quarter. See Sections 2, 3 and 4 for status reports of the Project Installation and Commissioning, the Environmental Monitoring activities and the Compliance Monitoring results for the period. Section 5 contains a list of Compliance Reports submitted to regulatory agencies during the period. The EMP describes in detail the environmental monitoring activities to be performed during the project execution. The purpose of the EMP is to: (1) document the extent of compliance of monitoring activities, i.e. those monitoring required to meet permit requirements, (2) confirm the specific impacts predicted in the National Environmental Policy Act documentation, and (3) establish an information base for the assessment of the environmental performance of the technology demonstrated by the project.

2515 (DOE/PC/89658–T4) **Innovative coke oven gas cleaning system for retrofit applications: Quarterly environmental monitoring report No. 1, January 1, 1991–June 30, 1991.** Bethlehem Steel Corp., PA (United States). 24 Aug 1992. 19p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FC22-90PC89658. Order Number DE93004943. Source: OSTI; NTIS; GPO Dep.

The coke plant at the Sparrows Point Plant consist of three coke oven batteries and two coal chemical plants. The by-product coke oven gas (COG) consists primarily of hydrogen, methane, carbon monoxide, nitrogen and contaminants consisting of tars, light oils (benzene, toluene, and xylene) hydrogen sulfide, ammonia, water vapor and other hydrocarbons. This raw coke oven gas needs to be cleaned of most of its contaminants before it can be used as a fuel at other operations at the Sparrows Point Plant. In response to environmental concerns, BSC decided to replace much of the existing coke oven gas treatment facilities in the two coal chemical Plants (A and B) with a group of technologies consisting of: Secondary Cooling of the Coke oven Gas; Hydrogen Sulfide Removal;

Ammonia Removal; Deacification of Acid Gases Removed; Ammonia Distillation and Destruction; and, Sulfur Recovery. This combination of technologies will replace the existing ammonia removal system, the final coolers, hydrogen sulfide removal system and the sulfur recovery system. The existing wastewater treatment, tar recovery and one of the three light oil recovery systems will continue to be used to support the new innovative combination of COG treatment technologies.

2516 (DOE/PC/89658–T5) **Innovative coke oven gas cleaning system for retrofit applications: Quarterly environmental monitoring report No. 2, July 1, 1991–September 30, 1991.** Bethlehem Steel Corp., PA (United States). 21 Sep 1992. 19p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FC22-90PC89658. Order Number DE93004942. Source: OSTI; NTIS; GPO Dep.

The EMP consists of a Compliance Monitoring Sampling Program and a Supplemental monitoring Sampling Program. The Compliance Monitoring Sampling Program will be conducted during a summer and a winter Baseline periods during the Pre-Construction/Construction phases of the Project and during a summer and a winter period following the successful Startup and Operational phase of the completed Project. compliance monitoring consist of conducting all the sampling and observation programs associated with existing required Federal, State, and Local Regulations, Permits and Orders. These include air, water, and waste monitoring and OSHA and NESHAP monitoring. The Supplemental Monitoring Program will also be conducted during a summer and a winter Baseline periods during the Pre-Construction/Construction phases of the Demonstration Facility and during a summer and a winter period following the successful startup and Operational phase of the completed Facility. Supplemental Monitoring includes sampling of 27 additional streams that are important to measure operational or environmental performance and impacts of the installation of the new COG treatment facilities.

2517 (DOE/PC/89760–T11) **A model approach to highly dispersing catalytic materials in coal for gasification: Eleventh quarterly report, April 1, 1992–June 30, 1992.** Abotsi, G.M.K.; Bota, K.B. Clark Atlanta Univ., GA (United States). Research Center for Science and Technology. [1992]. 10p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG22-89PC89760. Order Number DE93001269. Source: OSTI; NTIS; GPO Dep.

This project seeks to develop a technique, based on coal surface properties, for highly dispersing catalysts in coal for gasification and to investigate the potential of using potassium carbonate and calcium acetate mixtures as catalysts for coal gasification. The lower cost and higher catalytic activity of the latter compound will produce economic benefits by reducing the amount of K_2CO_3 required for high coal char reactivities. As was shown in previous reports, coal loading with potassium or calcium at different pHs produced CO_2 gasification activities which increased in the order pH 6 > pH 10 >>pH 1. A similar trend was obtained when calcium and potassium were simultaneously loaded and char reaction times were less than about 75 min. In the last quarter, the potential application of ammonia as a reactive medium for coal gasification has been investigated. This gas has not been previously applied to coal gasification. However, related work suggests that the potential chemical feedstock base can be broadened by using ammonia to generate hydrogen cyanide and cyanogen from coal. The current report shows that the reactivity of a demineralized lignite in ammonia is significantly higher in the presence of calcium or potassium catalyst than that for the char without added catalyst and suggests that ammonia is a potentially reactive gas for catalyzed coal gasification.

2518 (DOE/PC/89770–T13) **Preconversion catalytic deoxygenation of phenolic functional groups: Quarterly technical progress report, April 1, 1992–June 30, 1992.** Kubiak, C.P. Purdue Univ., Lafayette, IN (United States). Dept. of Chemistry. [1992]. 8p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG22-89PC89770. Order Number DE93002941. Source: OSTI; NTIS; GPO Dep.

Aryl carbon-oxygen bond cleavage is a chemical transformation of importance in coal liquefaction and the upgrading of coal liquids as well as in the synthesis of natural products. There have been numerous attempts to discover general methods for the cleavage of aryl carbon-oxygen bonds. All the stoichiometric organic methods for phenol deoxygenation have limited applications and involve expensive reagents. Catalytic method, for the hydrodeoxygenation (HDO) of phenols involve supported transition metal oxides, such as Mo/γ-Al_2O_3, Ni-MO/γ-Al_2O_3, Co-Mo/γ-Al_2O_3, and Fe_2O_3/SiO_2. Typical phenol hydrodeoxygenation conditions involve hydrogen pressures in excess of 100 atm and temperatures in excess of 200°C. Under these conditions arene ring hydrogenation is generally found to compete with phenol deoxygenation; and the coproduct water is found to impair the activity of the catalysts. This proposed research offers the possibility of effecting the selective catalytic deoxygenation of phenolic functional groups using CO. The deoxygenation of phenols by carbon monoxide mediated by Ir(triphos)OAr has provided us with a catalytic Phenol deoxygenation pathway, through the elimination of CO_2 and formation of a benzyne intermediate. Although the [Pt(triphos)(O-Ph-Me)]PF_6 system is not expected to be as efficient a catalyst as some of the other transition metals systems we are currently exploring, it will provide more information about the deoxygenation mechanism in these triphos complexes. This is due to the presence of the structurally sensitive ^{31}P–^{195}Pt coupling constant and comparisons to the extensively studied Pt(dppe)(O-Ph)$_2$ systems.

2519 (DOE/PC/89793–T5) **Undergraduate research studies program at participating institutions of the HBCU Fossil Energy Consortium: Final report.** Bota, K.B. Clark Atlanta Univ., GA (United States). [1991]. 18p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG22-89PC89793. Order Number DE93003853. Source: OSTI; NTIS; GPO Dep.

The primary objective of this research program is to expose students in the Historically Black Colleges and Universities (HBCU) Fossil Energy Consortium Institutions to energy and fossil fuels research, to stimulate their interest in the sciences and engineering and to encourage them to pursue graduate studies. This report provides the research accomplishment of the various students who participated in the program. Research results are presented on the following topics: Energy Enhancement and Pollutant Reduction in Coal by Cryogenic Diminution; Competition of NO and SO_2 for OH Generated witin Electrical Aerosol Analyzers; Dispersed Iron Catalysts for Coal Gasification; NQR/NMR Studies of Copper-Cobalt Catalysts for Syngas Concersion; Catalytic gasification of Coal Chars by Potassium Sulfate and Ferrous Sulfate Mixtures; A New Method for Cleaning and Beneficiation of Ultrafine Coal; Characterization Studies of Coal-Derived Liquids; Study of Coal Liquefaction Catalysts and Removal of Certain Toxic Heavy Metal Ions from Coal Conversion Process Wastewaters.

2520 (DOE/PC/89851–T4, pp. 1-13) **Overview of research conducted by the Consortium for Fossil Fuel Liquefaction Science.** Huffman, G.P. (Consortium for Fossil Fuel Liquefaction Science, Lexington KY (United States)). Consortium for Fossil Fuel Liquefaction Science, Lexington, KY (United States). 28 May 1991. In *Cooperative research in coal liquefaction. Final report, May 4, 1989–May 3, 1990.* 408p. Order Number DE92000847. Source: OSTI; NTIS.

Significant progress was made by the CFFLS in the May, 1990 to May, 1991 contract period in three primary coal liquefaction research areas: catalysis, structure-reactivity studies, and novel liquefaction research areas. A brief summary of the accomplishments in the past year in each of these areas is given below. The studies in this last area included identification of bacteria that will hydrogenate organic compounds and that can eventually be applied to coal; the investigation of advantages of the co-liquefaction of coal and lignin studies on solvent extraction kinetics using N-methyl pyrollidone as solvent; investigation of the complex chemistry of coal-oil coprocessing; and development of a slurry phase reaction capable of preventing retrogressive reactions from occurring.

2521 (DOE/PC/89851–T4, pp. 17-36) **Bioprocessing of coal.** Bhattacharyya, D.; Aleem, M.I.H.; Kermode, R.I.; Khalid, A.M.; Venkatachalam, H.; Paryavi, F. Consortium for Fossil Fuel Liquefaction Science, Lexington, KY (United States). 28 May 1991. In *Cooperative research in coal liquefaction. Final report, May 4, 1989–May 3, 1990.* 408p. Order Number DE92000847. Source: OSTI; NTIS.

In continuing with the search to identify bacteria that will hydrogenate organic compounds and can eventually be applied to coal, experiments were performed using Rhodopseudomonas plaustris, Desulfotomaculum nigrificans, Desulfovibrio desulfuricans and a fungus Poria placenta. The model compounds used were naphthalene, benzoic acid and diphenyl methane. Experiments were done to see the action of bacteria on coal (KCERL #91182). The effect of the bacteria was observed by UV spectroscopy in the aqueous phase. Sodium lactate and diphenyl methane proved to be good substrates for Rhodopseudomaonas palustris. Benzoic acid enhanced its growth on yeast extract while naphthalene showed some inhibitory effect. Desulfotomaculum nigrificans acting on naphthalene increased the total organic carbon in the aqueous phase thus implying that it had broken down naphthalene into more soluble products. Desulfovibrio desulfuricans acting on coal resulted in increased absorbance and formation of more peaks in the UV spectra of the supernatant liquid phase. Coal was treated anaerobically with Sulfolobus brierleyi using appropriate media in an atmosphere of 15% CO_2 and 85% H_2. A selective removal of sulfur from the coal along with hydrogen sulfide production was observed. Also a literature review was used to identify potential microorganisms that would be suitable for bioprocessing of coal.

2522 (DOE/PC/89851–T4, pp. 58-79) **Materials characterization study of coal liquefaction processes. Structure and size distributions of highly dispersed iron-based catalysts.** Huffman, G.P.; Ganguly, B.; Taghiei, M.; Huggins, F.E.; Shah, N. Consortium for Fossil Fuel Liquefaction Science, Lexington, KY (United States). 28 May 1991. In *Cooperative research in coal liquefaction. Final report, May 4, 1989–May 3, 1990.* 408p. Order Number DE92000847. Source: OSTI; NTIS.

Iron-based catalysts for direct coal liquefaction has been identified as a principal research thrust area for the CFFLS. Much of the research in the past year has been directed at developing new methods for utilizing Mossbauer and X-ray absorption fine structure (XAFS) spectroscopy for determining the size and structure of such catalysts in their initial, as-dispersed state, and at various stages of the liquefaction process. The results are summarized below.

2523 (DOE/PC/89851–T4, pp. 80-85) **Materials characterization study of coal liquefaction processes. Spectroscopic studies of the pyrolysis of organic sulfur compounds.** Clouthier, D.J. Consortium for Fossil Fuel Liquefaction Science, Lexington, KY (United States). 28 May 1991. In *Cooperative research in coal liquefaction. Final report, May 4, 1989–May 3, 1990.* 408p. Order Number DE92000847. Source: OSTI; NTIS.

Spectroscopic methods for the study of the pyrolysis processes of a variety of organic sulfur compounds have been developed. Thiophenoxy radicals have been detected directly by laser induced fluorescence in the pyrolysis products of phenyl disulfide. A pulsed pyrolysis jet source has been built, tested and proven to be a useful apparatus for producing pulses of pyrolysis products which are subsequently cooled by supersonic expansion. A new, precise wavelength calibration method has been developed for use with high resolution pulsed dye lasers in the 500-350 nm region.

2524 (DOE/PC/89851–T4, pp. 115-129) **Materials characterization study of coal liquefaction processes. Computer modeling of vitrinite.** Subbaswamy, K.R. Consortium for Fossil Fuel Liquefaction Science, Lexington, KY (United States). 28 May 1991. In *Cooperative research in coal liquefaction. Final report, May 4, 1989–May 3, 1990.* 408p. Order Number DE92000847. Source: OSTI; NTIS.

The author started the contract year with a study of the Shinn model for vitrinite. A fragment of the model was studied by the ASED-MO method described below. The geometry, the valence electron density, and bond dissociation energies were studied. For any modeling of coal to be significant, first it must be shown that the method employed in the study gives meaningful results for the model compounds for which experimental results are available. He, therefore, turned his attention to performing quantum chemical calculations on 4- (1-naphthylmethyl) bibenzyl (referred to hereafter as Model Compound I), studied recently by Farcasiu and Smith. In their experiments Farcasiu and Smith demonstrated the bond breaking selectivity of a novel catalyst, carbon black (BP 2000), and measured kinetic reaction rates and bond activation energies for cleavage of the methylene and ethylene linkages of the compound. In section 2 the specific semi-empirical method the author used is described. Section 3 contains his results for Model Compound I. In the next section the preliminary results for a small fragment of the Shinn model are discussed.

2525 (DOE/PC/89851–T4, pp. 133-140) **Novel approaches to catalysis in coprocessing and in the direct liquefaction of coal. Catalysis by soluble iron and molybdenum precursors for coprocessing of Argonne premium coals.** Wender, I.; Tierney, J.W. Consortium for Fossil Fuel Liquefaction Science, Lexington, KY (United States). 28 May 1991. In *Cooperative research in coal liquefaction. Final report, May 4, 1989–May 3, 1990.* 408p. Order Number DE92000847. Source: OSTI; NTIS.

One attempt to improve coal liquefaction catalysis involves the use of soluble catalyst precursors which decompose under reaction conditions to form very small catalyst particles. These precursors have the ability to make a high degree of coal-catalyst interaction possible. The use of soluble precursors containing iron has been studied extensively. The authors have previously reported the extent of dispersion of the catalyst produced from $Fe(CO)_5$ and its relationship with catalyst composition and activity at various stages of coprocessing reactions. This report concentrates mainly on the work done using $Fe(CO)_5$ for coprocessing reactions employing three Argonne premium coals of varying rank to determine if the catalyst was effective in the conversion of coals of different properties. The effect of adding very small amounts of molybdenum precursors (either $Mo(CO)_6$ or molybdenum naphthenate) to iron was was evaluated. Molybdenum catalysts usually possess a stronger hydrogenation ability than do iron catalysts, but they are relatively expensive compared to iron catalysts. It was expected that a combination of an iron catalyst with a small amount of molybdenum could achieve high conversions and oil yields without excessive catalyst cost.

2526 (DOE/PC/89851–T4, pp. 141-147) **Novel approaches to catalysis in coprocessing and in the direct liquefaction of coal. Coal liquefaction under mild conditions using triflic acid, iodine, and their combination.** Wender, I.; Tierney, J.W. Consortium for Fossil Fuel Liquefaction Science, Lexington, KY (United States). 28 May 1991. In *Cooperative research in coal liquefaction. Final report, May 4, 1989–May 3, 1990.* 408p. Order Number DE92000847. Source: OSTI; NTIS.

The concept of using a superacid coal depolymerization catalyst with a balancing hydrogenation/hydrogenolysis function to prevent retrogressive reactions forms the basis of this work. In an efficient coal dissolution process, macromolecular fragments of the coal structure should be selectively cleaved. While thermal cracking is non-selective and requires elevated temperatures, catalytic cracking can allow the use of less severe conditions. However, owing to the wide variety of the types of linkages existing in the coal structure, a single catalyst may not be sufficiently effective for bond breakage at critical linking points to allow for efficient coal conversion. Acid catalyzed coal depolymerization is a widely studied subject. Olah et al. treated Illinois No. 6 coal with a superacid system(H_0=−16) consisting of HF and BF_3 at about 105 C to obtain over 90% pyridine extractability. The authors chose to study the effect of triflic acid, a mild superacid (H_0=−14.2), on the hydroliquefaction of coal with or without small amounts of iodine as a hydrogenation co-catalyst.

2527 (DOE/PC/89851–T4, pp. 149-153) **Novel approaches to catalysis in coprocessing and in the direct liquefaction of coal. On the coliquefaction of coal with lignin.** Wender, I.; Tierney, J.W. Consortium for Fossil Fuel Liquefaction Science, Lexington, KY (United States). 28 May 1991. In *Cooperative research in coal liquefaction. Final report, May 4, 1989–May 3, 1990.* 408p. Order Number DE92000847. Source: OSTI; NTIS.

A short study was made to investigate the possible advantages of the coliquefaction of coal and lignin. The main reasons for looking into this subject were: (a) lignin is the second most abundant polymeric organic product in nature; (b) native lignin is a complex 3-dimensional polymer which contains about 0.3 wt% sulfur and essentially no nitrogen; additional lignin (in significant amounts) in coal liquefaction would cut down unwanted emissions; and (c) lignin-coal coliquefaction may increase distillate yields. A problem immediately became apparent: not only does the word 'lignin'

mean different things to different people but the difficulty and expense of obtaining pure 'native' lignin with low sulfur and nitrogen is too great for an investigation of coliquefaction to be worthwhile. A few experiments (without a catalyst) were run before the study was halted.

2528 (DOE/PC/89851–T4, pp. 157-161) **Liquefaction research in pyrolysis, catalysis and coal dissolution. Chemical routes to breaking bonds: New approaches to low temperature liquefaction.** Penn, J.H. Consortium for Fossil Fuel Liquefaction Science, Lexington, KY (United States). 28 May 1991. In *Cooperative research in coal liquefaction. Final report, May 4, 1989–May 3, 1990.* 408p. Order Number DE92000847. Source: OSTI; NTIS.

During the past year, the author has completed his evaluation of the abilities of quinones to enhance THF extractability of five different coals. These quinones include benzoquinone (BQ) and 2,3-dichloro-5,6-dicyanoquinone (DDQ). In addition to evaluating the potential of quinones to enhance extrability, he has also explored the use of the counterpart of benzoquinone, (i.e., dihydroquinone, DHQ) for its capabilities to induce enhanced extractability or liquefaction. The results of these studies show that BQ enhances liquefaction for only coal out of the five coals tested, while, in contrast, DHQ gives dramatically enhanced extractability at low temperatures for all five coals used in this study.

2529 (DOE/PC/89851–T4, pp. 163-171) **Liquefaction research in pyrolysis, catalysis and coal dissolution. Role of free radicals and catalysis-active sites in coal liquefaction.** Dalal, N.; DeLooze, J.P. Consortium for Fossil Fuel Liquefaction Science, Lexington, KY (United States). 28 May 1991. In *Cooperative research in coal liquefaction. Final report, May 4, 1989–May 3, 1990.* 408p. Order Number DE92000847. Source: OSTI; NTIS.

The lack of information about the chemical structure of coal-based radicals has been a major obstacle in the understanding of the structural-chemical reactivity relationship. Past research has indicated that the electron nuclear double resonance (ENDOR) technique has the potential of providing the most accurate structural information on the coal-based radicals. Unfortunately, the sensitivity of the best available ENDOR instrumentation was too low for liquefaction studies. During the current year, however, the authors have developed an ENDOR probe which yields an increase in the sensitivity of the technique that enables them to investigate the structural-chemical reactivity patterns of coal-based free radicals under mild conditions suitable for liquefaction. They have used this methodology to examine chemically characterized Illinois #6 at temperatures up to 200°C. A methodology was developed for the analysis of the resulting ENDOR signals in which three different types of protons were identified. Analyses were also performed on the temperature dependence of the ENDOR signal intensity. Efforts are currently being made to enhance the measurement methodology's sensitivity above 200°C.

2530 (DOE/PC/89851–T4, pp. 173-182) **Liquefaction research in pyrolysis, catalysis and coal dissolution. Kinetics of coal hydrogenation and cracking with Lewis acids.** Seehra, M.S.; Ibrahim, M.M. Consortium for Fossil Fuel Liquefaction Science, Lexington, KY (United States). 28 May 1991. In *Cooperative research in coal liquefaction. Final report, May 4, 1989–May 3, 1990.* 408p. Order Number DE92000847. Source: OSTI; NTIS.

The objectives of this research were to investigate the effect of Lewis acids ($ZnCl_2$, $ZnBr_2$, ZnI_2...) on the cracking and hydrogenation of coals, with particular attention to temperatures below 300°C, since the earlier studies were limited to higher temperatures. The proposal included the use of in-situ ESR (electron spin resonance) spectroscopy of free radicals generated in cracking and the use of TG/DTG (thermogravimetry/differential thermogravimetry) for measuring the mass loss and rate constants. Measurements show that at temperatures as low as 150 to 175°C, zinc halides promote approximately a 30% mass loss due to release of volatiles. A corresponding increase in the free radical density is observed from ESR spectroscopy in flowing nitrogen gas. These observations are interpreted in terms of coal cracking catalyzed by the zinc halides. The effect of H_2 gas is to lower the free radical density, presumably because of quenching of the free radical. The practical implications of these results are that significant liquefaction of coals at these low temperatures may be possible and that at these temperatures, the corrosive nature of zinc halides may not pose as severe a practical problem as encountered at higher temperatures.

2531 (DOE/PC/89851–T4, pp. 183-191) **Liquefaction research in pyrolysis, catalysis and coal dissolution. Low temperature extraction with supersolvents.** Zondlo, J.W.; Stansberry, P.; Stiller, A. Consortium for Fossil Fuel Liquefaction Science, Lexington, KY (United States). 28 May 1991. In *Cooperative research in coal liquefaction. Final report, May 4, 1989–May 3, 1990.* 408p. Order Number DE92000847. Source: OSTI; NTIS.

Extraction kinetics were measured for three different bituminous coals that exhibited distinct extraction behavior and characteristics. These kinetic data were modeled by a newly-developed reversible kinetic model. The model simulates not only the behavior of the extraction at short times, but can also be used to predict the ultimate extraction yield of each coal at any desired temperature. Removal of organic sulfur species was attempted using a metal: metal-salt redox couple. When applied to the raw coal, organic sulfur in the extract dropped from 2.38% down to 0.84%. Model compound studies showed the method to be applicable to thiol type linkages but not effective in debenzothiophenic bonds. Hydrogenation experiments using NMP both as a solvent during hydrogenation and as a catalyst impregnation solvent in pretreatment showed some effects on the overall product yield and distribution. Shifts in the product slate towards the heavier asphaltols indicated that the iron chloride catalyst promoted condensation reactions rather than further ring cleavage and hydrogenation. However, such experiments may be useful in the future for determining the effects of iron-based catalytic hydrogenation since the coal extracts as prepared do not contain any iron species.

2532 (DOE/PC/89851–T4, pp. 199-205) **Liquefaction research in pyrolysis, catalysis and coal dissolution. Evaluation of residue from the WVU coal extraction process as a disposable hydrotreatment catalyst.** Dadyburjor, D.B.; Clements, J.L. Consortium for Fossil Fuel Liquefaction Science, Lexington, KY (United States). 28 May 1991. In *Cooperative research in coal liquefaction. Final report, May 4, 1989–May 3, 1990.* 408p. Order Number DE92000847. Source: OSTI; NTIS.

The project has been studied in three phases. In the first phase, HDN tests were performed using a 30 ml bomb reactor under mild conditions (200°C, 2 hours reaction time and 200 psig initial pressure). In the second phase, tests were performed using a 300 ml Parr autoclave and stronger reaction conditions (350°C, 2 hours, 600 psig initial hydrogen pressure). Under phase 2 conditions, conversion of the model compound, quinoline to tetrahydroquinoline (a saturated product) was observed for the presulfided forms of all the catalysts studied (a Houdry Commercial Catalyst, KCER #91864 feed coal and KCER #91864 coal extraction process residue). However, the formation of nitrogen-free products only occurred with the commercial catalyst. A final phase of HDN tests is currently being performed to improve production of the nitrogen free products and the conversion of quinoline to its HDN products. The tests are being performed in the 300 ml Parr autoclave at 400°C, 4 hours of reaction time and 600 psig initial hydrogen pressure. Results are discussed.

2533 (DOE/PC/89851–T4, pp. 209-229) **Enhanced reactivity and selectivity in coal liquefaction and co-processing systems. Cyclic olefins: New donors for coal liquefaction and co-processing systems.** Curtis, C.; Guin, J.; Tarrer, R. Consortium for Fossil Fuel Liquefaction Science, Lexington, KY (United States). 28 May 1991. In *Cooperative research in coal liquefaction. Final report, May 4, 1989–May 3, 1990.* 408p. Order Number DE92000847. Source: OSTI; NTIS.

A new set of hydrogen donors, cyclic olefins, has been evaluated to determine their effectiveness as hydrogen donors to coal. These cyclic olefins, as well as their conventional hydrogen donor analogues, were reacted with Western Kentucky No. 9 coal under a variety of conditions. Also performed was a series of MNDO molecular orbital calculations to investigate the dehydrogenation pathway of isotetralin and tetralin. A comparison was made of three initial theoretical calculations to previous experimental work

involving the thermal reactivity of isotetralin and tetralin in a nitrogen atmosphere. Experimental procedures are described and results are discussed.

2534 (DOE/PC/89851–T4, pp. 231-241) **Enhanced reactivity and selectivity in coal liquefaction and co-processing systems. Catalytic coprocessing study using probe reactants.** Curtis, C.; Guin, J.; Tarrer, R. Consortium for Fossil Fuel Liquefaction Science, Lexington, KY (United States). 28 May 1991. In *Cooperative research in coal liquefaction. Final report, May 4, 1989–May 3, 1990.* 408p. Order Number DE92000847. Source: OSTI; NTIS.

Four model probe compounds were introduced to investigate the complex chemistry of coal-oil coprocessing reactions in this study. These four probe reactants served as monitors for evaluating the catalytic inhibitory effects of different hydrocarbonaceous substances. The four probe systems used were dibenzofuran for hydrodeoxygenation, dibenzothiophene for hydrodesulfurization, quinoline for hydrodenitrogenation, and anthracene for hydrogenation. The four models compounds were reacted individually with resid, coal, two different resid fractions and two prehydrogenated residuum, respectively, in order to discover how different compositional factors affected the reactivity of the individual probe reactions.

2535 (DOE/PC/89851–T4, pp. 243-260) **Enhanced reactivity and selectivity in coal liquefaction and coprocessing systems. Improved catalysts for coal liquefaction and coprocessing.** Curtis, C.; Guin, J.; Tarrer, R. Consortium for Fossil Fuel Liquefaction Science, Lexington, KY (United States). 28 May 1991. In *Cooperative research in coal liquefaction. Final report, May 4, 1989–May 3, 1990.* 408p. Order Number DE92000847. Source: OSTI; NTIS.

This year the authors have tested new bimodal and unimodal catalysts with a suite of additional coals from the DOE Argonne Coal Data Bank. They have also used the continuous CDS reactor to study the deactivation of these catalysts with model compound hydrogenation/demetallation reactions. In addition they have performed pore diffusion experiments to obtain effective diffusivities for these catalysts. Results in these areas are summarized.

2536 (DOE/PC/89851–T4, pp. 261-300) **Enhanced reactivity and selectivity in coal liquefaction and co-processing systems. Reduced coal liquefaction process severity through better hydrogen gas-liquid mass transfer.** Curtis, C.; Guin, J.; Tarrer, R. Consortium for Fossil Fuel Liquefaction Science, Lexington, KY (United States). 28 May 1991. In *Cooperative research in coal liquefaction. Final report, May 4, 1989–May 3, 1990.* 408p. Order Number DE92000847. Source: OSTI; NTIS.

A slurry phase reactor system was developed during this past year that offers sufficient versatility in reaction rate controllability and the necessary mass transfer/heat transfer characteristics to prevent retrogressive reactions from occurring due to H_2 starvation, while attaining a very high conversion of reactants. The reactor system was designed in order to control the rate of free-radical propagation so that only practical, achievable H_2 mass-transfer rates would be required. The more the H_2 mass-transfer rate is raised for each unit of reactor volume via the gas-liquid contactor design, the further the reactor's operational range can be extended over the period in which the rate of retrogressive reactions is low. The approach taken in developing the reactor system was, therefore, two-fold: (1) a reactant flow pattern was selected which would allow versatility in reaction rate controllability and (2) a gas-liquid contactor design was sought that provided the highest mass-transfer rates per unit volume without significantly affecting reaction rate controllability. Naphthalene hydrogenation was used as a model reaction to direct developmental efforts. A mathematical model for the reactor system was developed. The model was used extensively in interpreting experimental observations and parameterizing the system. Immediate plans are to evaluate the reactor system using tetralin oxidation as a model reaction. A mechanical high-shearing gas-liquid contactor now under construction will be used in these studies. Upon completion of these limited developmental studies, coal liquefaction studies will then be performed to observe the responses in product distribution to well-controlled liquefaction under high H_2 mass transfer rate conditions.

2537 (DOE/PC/89851–T4, pp. 305-328) **Integrated coal liquefaction/characterization. Coal structure/liquefaction yield correlation by means of advanced NMR techniques.** Curtis, C.; Guin, J.; Tarrer, R. Consortium for Fossil Fuel Liquefaction Science, Lexington, KY (United States). 28 May 1991. In *Cooperative research in coal liquefaction. Final report, May 4, 1989–May 3, 1990.* 408p. Order Number DE92000847. Source: OSTI; NTIS.

The work on this task has focused on developing procedures that increase the amount of information available on coals. Research activities included efforts to (1) use 2-dimensional NMR techniques for structure determination in liquids; and (2) the use of solid state NMR techniques to prove the structure of coals. A lengthy report on (1) was provided in the last quarter Progress Report and will not be duplicated as part of the Annual Report. Work on solid NMR techniques has been primarily in examination of ^{13}C chemical shielding anisotropy. The report provides a summary of the work carried out in this laboratory and a brief review of the work in the field that is guiding future activities.

2538 (DOE/PC/89851–T4, pp. 349-353) **Integrated coal liquefaction/characterization. Solvent extraction and pyrolysis.** Anderson, L.L. Consortium for Fossil Fuel Liquefaction Science, Lexington, KY (United States). 28 May 1991. In *Cooperative research in coal liquefaction. Final report, May 4, 1989–May 3, 1990.* 408p. Order Number DE92000847. Source: OSTI; NTIS.

Pyrolysis and solvent extraction of two additional Argonne Premium Coal Samples, namely Blind Canyon (HVB, Utah) and Lewiston-Stockton (HVB, West Virginia) have been studied. The reaction conditions were 350°C, 1 atmosphere of nitrogen (initial pressure) and a reaction time of 3 hours. Pyrolysis and solvent extraction yields of both coals and of three previously studied Argonne coals are shown in a table. Preliminary experiments on catalytic hydropyrolysis of Pittsburgh #8 coal were conducted using 'ferrophos' (a waste material produced in the electroreduction of phosphate ore to phosphorous) as a potential catalyst. The yields of tetrahydrofuran (THF) soluble along with THF insoluble products, are shown in another table. These results are discussed.

2539 (DOE/PC/89851–T4, pp. 355-366) **Integrated coal liquefaction/characterization. Low temperature depolymerization and liquefaction of Premium U.S. coal samples.** Shabtai, J.S. Consortium for Fossil Fuel Liquefaction Science, Lexington, KY (United States). 28 May 1991. In *Cooperative research in coal liquefaction. Final report, May 4, 1989–May 3, 1990.* 408p. Order Number DE92000847. Source: OSTI; NTIS.

Studies were performed on the improvement and application of a recently-developed procedure for low-temperature coal depolymerization-liquefaction. The procedure includes an initial depolymerization stage comprising two sequential low-temperature reaction steps in which different types of intercluster linkages are subjected to preferential cleavage, i.e., (1) intercalation of the coal with catalytic amounts of $FeCl_3$ followed by mild hydrotreatment (HT) of the coal-$FeCl_3$ intercalate; and (2) base-catalyzed depolymerization (BCD) of the product from step 1. In the final stage of the procedure, the depolymerized coal product from the HT-BCD treatment, consisting primarily of monocluster compounds, is subjected to hydroprocessing (HPR) with sulfided catalysts possessing augmented hydrogenolysis selectivity to obtain light hydrocarbon fuels as final products. Research activities during the reporting period included; (1) systematic studies on the processing aspects of the low-temperature depolymerization-liquefaction of three selected U.S. coals provided by the Argonne National Laboratory, i.e., Blind Canyon (UT), Beulah Zap (ND), and Pittsburgh #8 coals; (2) preparation of larger amounts of depolymerized coals for the purpose of in-depth characterization; (3) work on the simplification of the HT-BCD-HPR procedure and the development of alternative catalysts and solvents; and (4) elucidation of the chemistry and mode of catalytic action in each step of the procedure. Following is a summary of the main results obtained in the above-indicated areas.

2540 (DOE/PC/89851–T4, pp. 369-373) **Basic process/resource evaluation task. Coal maceral characterization and liquefaction.** Davis, B.; Milburn, D.; Keogh, R.A.; Dabbagh, H. Consortium for Fossil Fuel Liquefaction Science, Lexington, KY

(United States). 28 May 1991. In *Cooperative research in coal liquefaction. Final report, May 4, 1989–May 3, 1990.* 408p. Order Number DE92000847. Source: OSTI; NTIS.

The objectives of this study are to: obtain, if possible, a coal with equal distribution of the three major maceral groups (vitrinites, inertinites, and liptinites) for separation by density gradient centrifugation; characterize the maceral concentrates; liquefy the sample sets and characterize the products; and determine the thermal liquefaction pathway of the macerals. Results on all four parts of this study are given and discussed briefly.

2541 (DOE/PC/89851–T4, pp. 375-379) **Basic process/ resource evaluation task. Coal liquefaction catalysis.** Davis, B.; Milburn, D.; Keogh, R.A.; Dabbagh, H. Consortium for Fossil Fuel Liquefaction Science, Lexington, KY (United States). 28 May 1991. In *Cooperative research in coal liquefaction. Final report, May 4, 1989–May 3, 1990.* 408p. Order Number DE92000847. Source: OSTI; NTIS.

This study investigates sulfur isotope exchange during coal liquefaction. The present results, obtained at high pressure in a large 6 ton per day plant, show remarkable agreement with data reported for small scale, low pressure laboratory reactors. It is apparent that sulfur isotopes can be utilized in appropriate situations even in large scale reactors and at industrial/process conditions. The efforts expended in catalyst preparation and pretreatment to produce highly dispersed sulfides molybdenum species appear to be merited since at least two-thirds of the sulfur initially present in Ni-Mo-alumina catalysts exchanges very slowly. This is taken to indicate that the small molybdenum sulfide crystals retain their original structure for long time periods (days or months); if rapid reorganization of these crystals were to occur it is expected that sulfur exchange would quickly occur between the sulfur present in the reactant and the sulfur pool initially present in the catalyst.

2542 (DOE/PC/89851–T4, pp. 381-394) **Basic process/ resource evaluation task. The role of hydrogen during liquefaction using donor and non-donor solvents.** Davis, B.; Milburn, D.; Keogh, R.A.; Dabbagh, H. Consortium for Fossil Fuel Liquefaction Science, Lexington, KY (United States). 28 May 1991. In *Cooperative research in coal liquefaction. Final report, May 4, 1989–May 3, 1990.* 408p. Order Number DE92000847. Source: OSTI; NTIS.

An objective of this work was to understand how gaseous hydrogen (deuterium) is utilized during the conversion of a coal that has as high a conversion in a non-donor solvent (1-methylnaphthalene) as a good donor (tetralin). The effect of 1-methylnaphthalene-deuterium system on coal (Western Kentucky #9 coal) conversion was studied at 385°C and 450°C, ca. 2000 psi and reaction times of 15, 30, and 60 minutes. The liquefaction experiment was conducted in a microautoclave reactor of 50 ml capacity. After work-up, the oil fraction containing most of the 1-methylnaphthalene was subjected to GC-mass spectrometry. Small-scale, careful distillation of the oil fraction gave 1-methylnaphthalene (greater than 98% purity) for H-NMR analysis. The deuterium content of methylnaphthalene increased with increase in reaction time and temperature.

2543 (DOE/PC/89851–T4, pp. 395-408) **Basic process/ resource evaluation task. Liquefaction of U.S. coals.** Davis, B.; Milburn, D.; Keogh, R.A.; Dabbagh, H. Consortium for Fossil Fuel Liquefaction Science, Lexington, KY (United States). 28 May 1991. In *Cooperative research in coal liquefaction. Final report, May 4, 1989–May 3, 1990.* 408p. Order Number DE92000847. Source: OSTI; NTIS.

The objectives were to collect and characterize approximately 60 bench, channel and/or run of mine coal samples from Illinois, Ohio, West Virginia and/or Indiana; obtain liquefaction conversion data for the coals using the microautoclave reactors; obtain a detailed characterization of the liquefaction products for selected samples; continue establishing the relationship between coal properties and liquefaction responses; and construct and commission a CSTR liquefaction reactor. Results are given and briefly discussed for all five objectives.

2544 (DOE/PC/89883–50) **Coal liquefaction process streams characterization and evaluation: Quarterly technical progress report, January 1–March 31, 1992.** Robbins, G.A.; Brandes, S.D.; Winschel, R.A.; Burke, F.P. Consolidation Coal Co., Library, PA (United States). Research and Development Dept. Aug 1992. 129p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC22-89PC89883. Order Number DE93000646. Source: OSTI; NTIS; GPO Dep.

This is the tenth Quarterly Technical Progress Report under DOE Contract DE-AC22-89PC89883. Process oils from Wilsonville Run 262 were analyzed to provide information on process performance. Run 262 was operated from July 10 through September 30, 1991, in the thermal/catalytic Close-Coupled Integrated Two-Stage Liquefaction (CC-ITSL) configuration with ash recycle. The feed coal was Black Thunder Mine subbituminous coal. The high/low temperature sequence was used. Each reactor was operated at 50% of the available reactor volume. The interstage separator was in use throughout the run. The second-stage reactor was charged with aged Criterion 324 catalyst (Ni/Mo on 1/16 inch alumina extrudate support). Slurry catalysts and sulfiding agent were fed to the first-stage reactor. Molyvan L is an organometallic compound which contains 8.1% Mo, and is commercially available as an oil-soluble lubricant additive. It was used in Run 262 as a dispersed hydrogenation catalyst precursor, primarily to alleviate deposition problems which plagued past runs with Black Thunder coal. One test was made with little supported catalyst in the second stage. The role of phenolic groups in donor solvent properties was examined. In this study, four samples from direct liquefaction process oils were subjected to O-methylation of the phenolic groups, followed by chemical analysis and solvent quality testing.

2545 (DOE/PC/89883–51) **Coal liquefaction process streams characterization and evaluation: Characterization of coal-derived materials by field desorption mass spectrometry, two-dimensional nuclear magnetic resonance, supercritical fluid extraction, and supercritical fluid chromatography/mass spectrometry.** Campbell, J.A. (Battelle Pacific Northwest Lab., Richland, WA (United States)); Linehan, J.C.; Robins, W.H. Consolidation Coal Co., Library, PA (United States). Research and Development Dept.; Battelle Pacific Northwest Lab., Richland, WA (United States). Jul 1992. 179p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC22-89PC89883. Order Number DE93000465. Source: OSTI; NTIS; GPO Dep.

Under contract from the DOE , and in association with CONSOL Inc., Battelle, Pacific Northwest Laboratory (PNL) evaluated four principal and several complementary techniques for the analysis of non-distillable direct coal liquefaction materials in support of process development. Field desorption mass spectrometry (FDMS) and nuclear magnetic resonance (NMR) spectroscopic methods were examined for potential usefulness as techniques to elucidate the chemical structure of residual (nondistillable) direct coal liquefaction derived materials. Supercritical fluid extraction (SFE) and supercritical fluid chromatography/mass spectrometry (SFC/MS) were evaluated for effectiveness in compound-class separation and identification of residual materials. Liquid chromatography (including microcolumn) separation techniques, gas chromatography/mass spectrometry (GC/MS), mass spectrometry/mass spectrometry (MS/MS), and GC/Fourier transform infrared (FTIR) spectroscopy methods were applied to supercritical fluid extracts. The full report authored by the PNL researchers is presented here. The following assessment briefly highlights the major findings of the project, and evaluates the potential of the methods for application to coal liquefaction materials. These results will be incorporated by CONSOL into a general overview of the application of novel analytical techniques to coal-derived materials at the conclusion of CONSOL's contract.

2546 (DOE/PC/90027–T3) **Baseline design/economics for advanced Fischer-Tropsch technology: Quarterly report, April–June 1992.** Bechtel Corp., San Francisco, CA (United States); Amoco Corp., Chicago, IL (United States). [1992]. 91p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC22-91PC90027. Order Number DE93000910. Source: OSTI; NTIS; GPO Dep.

Effective September 26, 1991, Bechtel, with Amoco as the main subcontractor, initiated a study to develop a computer model and baseline design for advanced Fischer-Tropsch (F-T) technology for the US Department of Energy's Pittsburgh Energy Technology Center (PETC). The objectives of the study are to: Develop a baseline

design for indirect liquefaction using advanced F-T technology; prepare the capital and operating costs for the baseline design; and develop a process flow sheet simulation (PI-S) model. The baseline design, the economic analysis, and the computer model win be the major research planning tools that PETC will use to plan, guide, and evaluate its ongoing and future research and commercialization programs relating to indirect coal liquefaction. for the manufacture of synthetic liquid fuels from coal. This report is Bechtel's third quarterly technical progress report covering the period from March 16, 1992 through June 21, 1992. This report consists of seven sections: Section 1 - introduction; Section 2 - summary; Section 3 - carbon dioxide removal tradeoff study; Section 4 - preliminary plant designs for coal preparation; Section 5 - preliminary design for syngas production; Section 6 - Task 3 - engineering design criteria; and Section 7 - project management.

2547 (DOE/PC/91052–3) **Optimization of reactor configuration in coal liquefaction: Third quarterly report, 1 April 1992–30 June 1992.** Comolli, A.G.; Johanson, E.S.; Lee, L.K. Hydrocarbon Research, Inc., Princeton, NJ (United States). Jan 1992. 14p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC22-91PC91052. Order Number DE93004921. Source: OSTI; NTIS; GPO Dep.

During the third quarter of the program, experimental work had commenced on microautoclave evaluation of partially converted coal slurry obtained from PDU Run 260-03. Additional conversion of coal in the noncatalytic and catalytic tests was observed. However, the increase in coal conversion was lower than previous tests on the HRI-5887 shipment of Black Thunder Mine coal prepared by Empire Coke Company. Microautoclave tests on coal used as feed in the PDU Run 260-03 are being evaluated under the CTSL program. Retrofitting of a small continuous flow unit for fixed bed processing of partially converted coal slurry had commenced in June and is expected to completed by the end of July. The fixed bed test program is scheduled to start in mid-August. A batch of presulfided Shell S-317 1/20 in. trilobe catalyst had been obtained from Wilsonville and was characterized during this period. The Mo/Ni ratio of the presulfided trilobe catalyst was very similar to that of the fresh Shell S-317 1/32 in. extrudates. As a result of the presulfiding procedure, part of the pore structure (24%) was blocked by carbonaceous deposits. However, the pore size distribution of the trilobe catalyst remained about the same as the fresh 1/32 in. extrudate.

2548 (DOE/PC/91281–T4) **Low severity coal liquefaction promoted by cyclic olefins: Quarterly report, January–March 1992.** Curtis, C.W. Auburn Univ., AL (United States). Dept. of Chemical Engineering. [1992]. 8p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG22-91PC91281. Order Number DE92041290. Source: OSTI; NTIS; GPO Dep.

The naphthalene hydrogenation performed thermally at 350 and 400°C showed no reactivity of the naphthalene. The Molyvan L catalyst precursor promoted a small amount of hydrogenation of naphthalene at 400°C as shown in Table 1. Reaction at the higher initial pressure of 1250 psi resulted in slightly more conversion of naplithalene and a higher production of tetralin but no decalin was observed. The naphthalene hydrogenation reactions with Molyvan L without sulfur yielded a slightly higher % HYD of naphthalene than did the reactions with sulfur. Likewise, the reactions with an initial hydrogen pressure of 1250 psi yielded a higher % HYD of naphthalene than did the reaction with 1000 psi, regardless of whether sulfur was present. The Molyvan 822 catalyst precursor was substantially more active at 400°C than at 350°C as presented in Table 2. The presence of sulfur also promoted the activity of Molyvan 822 as a catalyst. Tetralin was the product and was produced in substantial quantities at 400°C. Molyvan 822 was much more active for naphthalene hydrogenation than was Molyvan L under equivalent conditions. For example, at 400°C with sulfur the reactions with Molyvan 822 produced 33.5% HYD while Molyvan L yielded 1.8% HYD. With Molyvan L, the less active catalyst, the effect tile mode of agitation (vertical or horizontal) was minimal.

2549 (DOE/PC/91334–T89) **Continuous bench-scale tests to assess METHOXYCOAL process performance: Technical report, March 1–May 31, 1992.** Knight, R.A. (Institute of Gas Technology, Chicago, IL (United States)); Carty, R.H. Illinois Dept. of Energy and Natural Resources, Springfield, IL (United States). [1992]. 21p. Sponsored by USDOE, Washington, DC (United States); Illinois Dept. of Energy and Natural Resources, Springfield, IL (United States). DOE Contract FG22-91PC91334. Order Number DE93000957. Source: OSTI; NTIS; GPO Dep.

Laboratory-scale research conducted at Southern Illinois University at Carbondale (SIUC) has shown that coal pyrolysis in the presence of CH_4 and small quantities of O_2 (the METHOXYCOAL process) can produce higher yields of liquids and valuable chemicals than conventional pyrolysis. The addition of MgO, coal ash, and clays have been reported to further enhance coal conversion. The goal of this two-year project is to build upon that laboratory research by conducting continuous bench-scale tests at ICT. Tests are being conducted with IBC-101 coal under GH_4/O_2 blends with and without added coal ash, MgO, and/or clays, at temperatures and pressures up to 1000°F and 200 psig. These tests will provide data to select operating conditions for maximum production of PCX (phenol, cresols, and xylenols) from high-sulfur Illinois coals. During the third quarter, data from IGT and SIUC have been analyzed and compared, and these data suggest that increased coal conversion to liquids and to PCX requires a longer residence time of volatile precursors in contact with hot char than can be obtained in the fluidized bed. Consequently, we have decided to operate future tests in a moving-bed reactor.

2550 (DOE/PC/91334–T90) **Integrated methods for production of clean char and its combustion properties: [Quarterly] report, March 1, 1992–May 31, 1992.** DeBarr, J.A. (Illinois State Geological Survey, Champaign, IL (United States)); Rostam-Abadi, M.; Gullett, B.K.; Benson, S.A.; Toman, D.L. Illinois State Geological Survey, Champaign, IL (United States). [1992]. 19p. Sponsored by USDOE, Washington, DC (United States); Illinois Dept. of Energy and Natural Resources, Springfield, IL (United States). DOE Contract FG22-91PC91334. Order Number DE93000956. Source: OSTI; NTIS; GPO Dep.

The objective of this program is to produce chars with SO_2 emissions at least 50% lower than those of the parent coals, and which at minimum meet the year 1995 emission standard of 2.5 lbs SO_2/MMBtu. This will be accomplished using an integrated process which combines physical coal cleaning, mild gasification and char desulfurization. This project is a cooperative effort between the ISGS, UNDEERC and the US EPA and is cost-shared with the US EPA and the US DOE through UNDEERC. Mild gasification and char desulfurization studies are conducted in a batch fluidized-bed reactor and a continuous rotary kiln reactor using six coals selected from the Illinois Basin Coal (IBC) Sample Program. Burning characteristics and ash deposition behaviors of desulfurized chars are determined at the US EPA in a 14 kill pilot-scale combustor and at UNDEERC in a drop tube furnace (DTF). Complete analyses of the fuels are obtained to aid char desulfurization studies and help explain combustion and SO_2 emission characteristics of the chars. During this reporting period, preliminary low temperature oxidation (LTO) studies were conducted to desulfurize chars derived from mild gasification. Under non-optimized conditions, SO_2 emissions (lbs SO_2/MMBtu) of the six coals were reduced over 60%. Physical coal cleaning, mild gasification and char desulfurization reduced the SO_2 emissions of two of the coals nearly 70%. Chars prepared from four of the six coals tested had SO_2 emissions of less than 2.5 lbs SO_2/MMBtu. The average yield of low sulfur char obtained after pyrolysis and LTO was nearly 64% by weight of the original coal. Thermogravimetric (TG) experiments showed that LTO chars are easier to burn than mild gasification chars, due to an increase in surface areas of desulfurized chars during oxygen treatment. Surface areas measured by nitrogen adsorption were 126 to 234 m^2/g for LTO chars and <5 m^2/g for mild gasification chars.

2551 (DOE/PC/91334–T91) **Investigation of a technique for sulfur reduction of mild gasification char: Technical report, March 1–May 31, 1992.** Knight, R.A. (Institute of Gas Technology, Chicago, IL (United States)). Illinois Dept. of Energy and Natural Resources, Springfield, IL (United States). [1992]. 19p. Sponsored by USDOE, Washington, DC (United States); Illinois Dept. of Energy and Natural Resources, Springfield, IL (United States). DOE Contract FG22-91PC91334. Order Number DE93000955. Source: OSTI; NTIS; GPO Dep.

The object of this program is to investigate the desulfurization of mild gasification char using H_2:CH_4 mixtures at the laboratory scale. Mild gasification is a coal conversion technique which produces solid, liquid, and gaseous co-products at 1100°–1500°F and near-ambient pressure. Char comprises about 60 to 70% of the dry coal yield. Form coke for steelmaking and foundries presents potential high-value markets for chars from eastern bituminous coals. Conventional metallurgical cokes generally contain less than 1 wt% sulfur, and mild gasification char from high-sulfur Illinois coals must be upgraded to meet these criteria. One method to accomplish this is desulfurization with reducing gases derived from the co-product gases. Because form coke has a market value up to $200/ton, it can accommodate desulfurization costs and still be economically attractive. In the first year of the two-year program, granular char is being treated with H_2:CH_4 blends at temperatures of 1100°–1600°F and pressures of 50–200 psig. The effects of temperature, pressure, residence time, gas velocity, and gas composition on sulfur removal and carbon gasification are being determined. During the third quarter, 10 tests were performed with four chars. Fluidized-bed tests were conducted at 1400–1600°F, 50–200 psig, and 120–240 min residence time. Future tests will focus on determining the key properties that determine the susceptibility of char to hydrodesulfurization with minimal carbon conversion.

2552 (ETDE-mf–93728906) **Operation of a 10 t/h-prototype plant applying the VEW coal conversion process (pressurized operation). Final report.** Weinzierl, K.; Deggim, D.; Gerber, R.; Poller, J.; Seum, J.; Stoppa, N. Gesellschaft zur Vergasung von Steinkohle mbH, Dortmund (Germany); Bundesministerium fuer Forschung und Technologie, Bonn (Germany). Oct 1991 95p. (In German). Contract BMFT 0321269C. Order Number DE93728906. Source: OSTI; NTIS (US Sales Only).

The report comprises the operation period of the 10 t/h-prototype plant from June 1989 until January 1991. The test operation of the gasification was successfully completed. The technological qualification and the long-term operability of the technological new components were verified. In the waste heat recovery section the more world-wide unique generation of superheated high-pressure steam in a coal gasification plant was demonstrated. The test results show that the air-blown entrained flow partial gasification represents a suitable component for the hard coal-based combined cycle process. In the gas cleaning section the wet-type halogen separation from the coal gas was carried out successfully. The parallel operated dry gas cleaning plant demonstrated the qualification of the process for the halogen separation in principle. With that technical solutions are available for a general plant applying the VEW-coal conversion process as well as for the application in different process developments. (orig.) With 1 tab., 34 figs.

2553 (ORNL–6719) **Fossil Energy Program semiannual progress report for April 1991 through September 1991.** Judkins, R.R. Oak Ridge National Lab., TN (United States). Oct 1992. 151p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. Order Number DE93002624. Source: OSTI; NTIS; GPO Dep.

This report covers progress made during the period April 1, 1991, through September 30, 1991, for research and development projects that contribute to the advancement of various fossil energy technologies. Projects on the Fossil Energy Program are supported by the DOE Office of Fossil Energy, the DOE Morgantown Energy Technology Center, the DOE Pittsburgh Energy Technology Center, the DOE Fossil Energy Clean Coal Technology Program, the DOE Fossil Energy Office of Petroleum Reserves, and the US Agency for International Development (USAID). The Fossil Energy Program organization chart is shown in the appendix. Project discussed are: materials research and development; environmental analysis support; coal conversion development; coal combustion research; fossil fuel supplies modeling and research; evaluations and assessments; and coal structure and chemistry.

2554 **Hot gas desulfurization sorbent and method.** Gasper-Galvin, L.D.; Atimtay, A.T. To Dept. of Energy. 13 Mar 1991. USAA patent application 7-668,52. 32p. Sponsored by USDOE, Washington, DC (United States). Order Number DE93002023. Source: OSTI; NTIS; GPO Dep.

A multiple metal oxide sorbent supported on a zeolite of substantially silicon oxide is used for the desulfurization of process gas streams, such as from a coal gasifier, at temperatures in the range of about 1200° to about 1600°F. The sorbent is provided by a mixture of copper oxide and manganese oxide and preferably such a mixture with molybdenum oxide. The manganese oxide and the molybdenum are believed to function as promoters for the reaction of hydrogen sulfide with copper oxide. Also, the manganese oxide inhibits the volatilization of the molybdenum oxide at the higher temperatures.

0105 Products and By-Products

Refer also to citation(s) 2515

0106 Properties and Composition

Refer also to citation(s) 2529, 2537, 2540, 2543, 2553, 2594, 3774, 3795

2555 (DOE/PC/79903–T14) **Optical properties of flyash: Quarterly report, 1 April–30 June 1990.** Self, S.A. Stanford Univ., CA (United States). High Temperature Gasdynamics Lab. Jul 1990. 50p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC22-87PC79903. Order Number DE92041182. Source: OSTI; NTIS; GPO Dep.

The chemical composition and size distribution of representative flyashes are being measured by appropriate microanalytical techniques to provide information required. Measurements of the infrared optical constants (i.e., the complex refractive index m = n - ik) of synthetic slags are being made as a function of wavelength and temperature for controlled compositions. Particular attention will be given to the contribution of the Fe_2O_3 content and its valence state. The data is being reduced to yield formulae giving the complex refractive index over relevant ranges of wavelength and temperature, as a function of the relevant metal oxide constituents. A benchscale experiment is planned to compare the measured radiant properties of a dispersion of well-characterized ash with computations based on data developed under the first two tasks.

2556 (DOE/PC/79903–T16) **Optical properties of flyash: Quarterly report, 1 October–31 December 1989.** Self, S.A. Stanford Univ., CA (United States). High Temperature Gasdynamics Lab. Jan 1990. 30p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC22-87PC79903. Order Number DE92041305. Source: OSTI; NTIS; GPO Dep.

During the past quarter we have successfully measured the near normal reflectance of synthetic slags SA00, SA01, and SA05 at 1600°C. The expected similarity of the measurements for slags SA00 and SA01 (which have nearly the same composition) reinforces our conclusion that the experiment is repeatable, although more data will certainly be taken to ensure this. The Kramers-Kronig relations have been applied to the reflectance data to obtain n in the wavelength range 1–13 μm and k in the wavelength range 8–13 μ. The results show the expected strong SiO_2 absorption band in k and the related dispersion in n. Currently we are examining the results from Task 1 to establish the slag compositions that are most representative of the majority of ash particles so that appropriate measurements can be made. Compositions will be limited to those which bear significantly on the radiation heat transfer in coal combustors. Once these compositions are established, a limited number of new synthetic slags will be made and their optical properties will be measured.

2557 (DOE/PC/89757–8) **Thermodynamics and surface structure of coals: Quarterly report, July 1, 1991–September 31, 1991.** Glass, A.S.; Larsen, J.W.; Quay, D.M.; Roberts, J.E.; Wernett, P.C. Lehigh Univ., Bethlehem, PA (United States). Dept. of Chemistry. [1991]. 18p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC22-89PC89757. Order Number DE92040016. Source: OSTI; NTIS; GPO Dep.

Our work this month has been determining the effect of added surface dysprosium(III) ions on the NMR spectra of coal. We have also been examining the effect of this relaxation agent on our model system, an aryl sulfonate silica gel. To the best of our

knowledge, NMR has not previously been. applied to surface studies of coal. It is a powerful technique because line positions and intensities are indicative of geometry, bonding hybridization and population of distinct functionalities as well as local environment effects. The NMR spectrum can be influenced by many factors including dipolar through-space coupling between an unpaired electron spin and the spin of the carbon atom. The unpaired electron can act as a relaxation sink, significantly shortening the spin-lattice relaxation time (T_1) of the coupled carbon-13 atom. This shortening of the T_1 can broaden the signal to the point where it disappears into the baseline noise. The effective range of interaction is proportional to the inverse sixth power of the separation of the two spins (r^{-6}). In this system, the effective range is a relatively short distance on the order of 1 nanometer.

2558 (DOE/PC/89764–T9) **Permeability changes in coal resulting from gas desorption: Quarterly report, August 16, 1989–November 15, 1989.** Alabama Univ., University, AL (United States). [1989]. 9p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG22-89PC89764. Order Number DE92041296. Source: OSTI; NTIS; GPO Dep.

The goal of this task is to accurately measure the elongation and shrinkage exhibited by coal as it sorbs and desorbs methane gas at elevated pressure. Our research group has discussed several possible methods to measure this strain, including: optical microscopy, laser interferometry, conventional strain gauges, and LVDT strain gauges. There are advantages and disadvantages of each method. We had planned to use optical microscopy but, on further investigation, this approach will be less satisfactory than the strain gauge method. Accordingly, we have switched our focws to the use of strain gauges. Conventional strain gauges also involve potential problems which must be overcome, including: (1) Contrast in strength between the coal and the strain gauge must be minimized, (2) The proper glue that is neither too strong or too weak must be used to affix the strain gauge to the coal or the strain in the coal will not be accurately transmitted to the gauge, and (3) We must be aware that the total strain in the coal may not be homogeneously distributed through the specimen (due either either to boundary effects or contrast in composition of the coal layers). A high pressure chamber for sorption-strain experiments is currently being tested an modified and tested. The chamber will accommodate several small blocks of coal simultaneously. This will optimize efficiency, owing to the long times required to reequilibrate the coal blocks to changes in methane pressure.

2559 (DOE/PC/89785–T1) **The single electron chemistry of coals, January 1, 1990–March 30, 1990.** Larsen, J.W.; Flowers, R.A. II. Lehigh Univ., Bethlehem, PA (United States). Dept. of Chemistry. 16 Apr 1990. 14p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG22-89PC89785. Order Number DE92041298. Source: OSTI; NTIS; GPO Dep.

The Wyodak, Upper Freeport and Pocahontas No. 3 samples containing DPPD display a decrease in spin density as compared to the starting coals. Coincident with this decrease is a loss or decrease of the narrow inertinite signal in the esr spectrum of these coals. The Pittsburgh No. 8 coal sample containing DPPD also displays a loss of spin density as compared to the starting coal but there is no change in the esr spectrum. These results compare well with earlier work involving 4-vinylpyridine and the same coal samples. We discovered the presence of poly(4-vinylpyridine) in our coal samples and a concurrent loss of inertinite radical density. It is possible that the inertinite radicals may initiate the polymerization or in the present work may abstract hydrogen from DPPD. No C=N stretch was displayed in the IR spectrum to substantiate this claim.

2560 (DOE/PC/89785–T2) **The single electron chemistry of coals: [Quarterly], April 1–June 30, 1992.** Larsen, J.W.; Eskay, T.P. Lehigh Univ., Bethlehem, PA (United States). Dept. of Chemistry. [1992]. 10p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG22-89PC89785. Order Number DE92041288. Source: OSTI; NTIS; GPO Dep.

Depolymerization of coals at low temperatures may offer advantages over thermal bond cleavage. Because bond cleavage energies of radical cations are lower than the corresponding homolytic bond cleavage energies of the same bond, generation of radical cations in coal may make possible depolymerization at lower temperatures. We seek to investigate the above possibility using single molecules containing functional groups common in coals. Since the generation of a radical cation requires the removal of an electron from a neutral molecule, a primary focus of the study will be finding oxidants that will remove an electron from compounds with structural similarity to those typically found in coals. The study will also be concerned with the decomposition of radical cations and the products formed as a result of the decomposition.

2561 (DOE/PC/89851–T4, pp. 37-57) **Materials characterization study of coal liquefaction processes. XAFS and Mossbauer spectroscopy and CCSEM studies of coals of interest in the CFFLS program.** Shah, N.; Huggins, F.E.; Huffman, G.P. Consortium for Fossil Fuel Liquefaction Science, Lexington, KY (United States). 28 May 1991. In *Cooperative research in coal liquefaction. Final report, May 4, 1989–May 3, 1990.* 408p. Order Number DE92000847. Source: OSTI; NTIS.

The CFFLS has decided to concentrate much of its research effort on the Argonne Premium coal samples, in order to facilitate comparison of results from different investigators at different CFFLS universities. Because mineral matter and sulfur forms can significantly affect liquefaction behavior, the authors have carried out detailed characterization of these coal properties by computer-controlled scanning electron microscopy (CCSEM), Mossbauer spectroscopy, and X-ray absorption fine structure (XAFS) spectroscopy. In order to obtain more meaningful correlations with liquefaction behavior, the data set was augmented by investigating eight Kentucky coals selected form many coals to exhibit a range of sulfur contents, rank, and liquefaction yields. In order to maximize any catalytic or retrograde effects of mineral matter, the liquefaction experiments were carried out at a relatively low temperature (385°C) with tetralin as the solvent (1:1.5 coal/solvent ratio), without any added catalyst for a reaction time of 15 minutes. Microclaves (tubing bombs) were cold pressurized to 800 psi with hydrogen before heating to reaction conditions. Products of liquefaction were classified as: oils - pentane soluble; asphaltenes - pentane insoluble, benzene soluble; perasphaltenes - benzene insoluble, pyridine soluble; insoluble organic matter (IOM) - pyridine insolubles. Total conversion is defined as 100 - IOM. Results are given.

2562 (DOE/PC/89851–T4, pp. 86-114) **Materials characterization study of coal liquefaction processes. Surface characterization of coals by XPS.** Reucroft, P.J.; Kim, J.Y. Consortium for Fossil Fuel Liquefaction Science, Lexington, KY (United States). 28 May 1991. In *Cooperative research in coal liquefaction. Final report, May 4, 1989–May 3, 1990.* 408p. Order Number DE92000847. Source: OSTI; NTIS.

X-ray photoelectron spectroscopy has been used to study the surface characteristics of coal samples. The technique provides elemental identification and chemical information about the outmost 3-4 nm of the exposed surface of a solid. The surface composition of the coal samples was measured and compared with the results of bulk analysis. A good correlation with the bulk analysis was obtained for the total carbon and nitrogen using XPS quantitative analysis, although the accuracy of the XPS determinations seems to be lower, in quantitative analysis, although the accuracy of the XPS determinations seems to be lower, in view of uncertainties in determining sensitivity factors. The surface and bulk concentrations differ in the case of sulfur, oxygen, silicon, aluminum and iron. Silicon, aluminum, and oxygen are enriched at the surface, for example, while iron is surface depleted. Peak deconvolution was conducted to obtain information on the chemical environments of elements, such as sulfur, carbon and nitrogen. These results have been compared with model compound studies and good agreement was observed.

2563 (DOE/PC/89851–T4, pp. 193-198) **Liquefaction research in pyrolysis, catalysis and coal dissolution. Calculation of physical properties for complex fluids in coal liquefaction.** Whiting, W.B. Consortium for Fossil Fuel Liquefaction Science, Lexington, KY (United States). 28 May 1991. In *Cooperative research in coal liquefaction. Final report, May 4, 1989–May 3, 1990.* 408p. Order Number DE92000847. Source: OSTI; NTIS.

Process simulation and design of coal-liquefaction facilities require accurate physical-property-estimation techniques (esp. for

vapor-liquid equilibrium) that are compatible with computer-aided-design process simulators. However, the fluids encountered in coal liquefaction and in the processing of coal fluids are more complex than those encountered in other chemical processes; thus, they are not well described by existing physical-property-estimation packages. The author has developed models, algorithms, and computer software to address these requirements. Coal-derived fluids contain very many different species and characterization of the fluids is, therefore, complicated. To address this problem in a way that offers the efficiency and accuracy required for process simulation, he used the new technique of continuous thermodynamics. With this approach, he modeled the fluid as a continuous distribution of species according to one or more characterization variables. He has used molecular weight, normal boiling point, density, and PNA analyses as the characterization variables. Another problem with coal fluids is that they contain molecules, the structures of which dictate an activity-coefficient approach to vapor-liquid equilibria, rather than an equation-of-state approach. As previous work had dealt with equations of state, he extended continuous thermodynamics to activity- coefficient models. He is developing a group-contribution equation of state that allows the calculation of parameters for many systems.

2564 (DOE/PC/89851–T4, pp. 329-339) **Integrated coal liquefaction/characterization. Molecular weight determination of coal derived liquids by mass spectrometric techniques.** Meuaelaar, H.L.C.; Huai, H. Consortium for Fossil Fuel Liquefaction Science, Lexington, KY (United States). 28 May 1991. In *Cooperative research in coal liquefaction. Final report, May 4, 1989–May 3, 1990.* 408p. Order Number DE92000847. Source: OSTI; NTIS.

One of the most challenging tasks for analytical chemists involved in characterizing the molecular properties of coal derived liquid (CDL) is to obtain a reliable estimate of the molecular weight distribution. Due to the relatively high MW, aromaticity and/or polarity of the major components conventional MW determination techniques, e.g. based on colligative properties tend to perform poorly with coal liquids. Consequently, the authors felt prompted to undertake the development of a novel MW determination method based on MS measurement of the relationship between vacuum distillation temperature and average molecular weight in combination with thermogravimetric (TG) measurement of the relationship between vacuum distillation temperature and relative mass loss. Combination of these two measurements then produces the relationship between molecular weight and mass fraction, in other words the molecular weight distribution of the sample. Obviously, this method can only be applied to vacuum distillable components. Within this limitation, however, the technique is relatively insensitive to mass losses during sample introduction and/or MW dependent differences in instrument response. In order to test the applicability of the combined TG and MS approach to CDL tar oil fractions of four ANL coals (Beulah Zap, Illinois #6, Blind Canyon and Pittsburgh #8) produced by the Shabtai low temperature HTBCD (Hydrotreatment-Base Catalyzed Depolymerization) process were analyzed.

2565 (DOE/PC/89851–T4, pp. 341-347) **Integrated coal liquefaction/characterization. Fourier transform IR and chromatographic studies in coal liquefaction chemistry.** Eyring, E.M. Consortium for Fossil Fuel Liquefaction Science, Lexington, KY (United States). 28 May 1991. In *Cooperative research in coal liquefaction. Final report, May 4, 1989–May 3, 1990.* 408p. Order Number DE92000847. Source: OSTI; NTIS.

Acid catalysts are of interest for coal depolymerization since they offer the potential to liquefy-coals at low temperatures with a high selectivity for liquid product. Many metals halides have been examined to evaluate their potential as coal depolymerization catalysts. However, the nature of the depolymerization catalysts is still not well understood. The objective of the present work is to track the soluble iron catalyst in a low temperature coal depolymerization process (that of Joseph S. Shabtai) using electron microprobe analysis (EPM) and Mossbauer spectroscopy. The main part of the paper discusses this study. Two other studies are also briefly described: Benzene in zeolite ZSM-5 studied by DRIFTS and Photoacoustic enhancements of surface IR modes in zeolite channels.

2566 (DOE/PC/91310–4) **The use of solid-state NMR techniques for the analysis of water in coal and the effect of different coal drying techniques on the structure and reactivity of coal: Quarterly report, June 1, 1992–August 31, 1992.** Netzel, D.A. Western Research Inst., Laramie, WY (United States). [1992]. 5p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG22-91PC91310. Order Number DE93004923. Source: OSTI; NTIS; GPO Dep.

The results of measuring the change in moisture content of the Eagle Butte and Usebelli coals as a function of time are shown in Figure 1. As expected, the measured moisture content increases with time and reaches a maximum after about 8 hours. Two different types of sorbed water are removed sequentially. Free or surface sorbed water is rapidly removed followed by the water in the micropores of the coal as the reagents migrate into the pore structure. There appears to be an induction period of about 4 hours for the Eagle Butte coal before the moisture content increases more rapidly with time due to the reactions of the more "tightly bound or "pore" water with the reagents. The chemical drying experiment was repeated twice for the Usebelli coal. In the first experiment, aliquots of the reaction mixture were removed sequentially, and in the second experiment separate coal samples were prepared and allowed to stand until the appropriate time for the NMR spectrum to be acquired. Excellent reproducibility was obtained. Both cools were thermally dried by heating to 110°C for 1 hour. The moisture content was determined by weight loss. Using the thermal drying method, the Eagle Butte coal had a moisture content of 16.6 wt % and the Usebelli coal a moisture content of 14.1 wt %. These values are near the moisture content of coal as determined by chemical drying.

2567 (DOE/PC/91334–T94) **Lignin-assisted coal depolymerization: [Quarterly] report, March 1, 1992–May 31, 1992.** Lalvani, S.B.; Muchmore, C.B.; Koropchak, J.A.; Kim, Jong Won. Southern Illinois Univ., Carbondale, IL (United States). [1992]. 17p. Sponsored by USDOE, Washington, DC (United States); Illinois Dept. of Energy and Natural Resources, Springfield, IL (United States). DOE Contract FG22-91PC91334. Order Number DE93000949. Source: OSTI; NTIS; GPO Dep.

In the last report, it was shown that when lignin is added to coal, the rate of coal depolymerization is enhanced. The results,-reported were based upon a number of experiments conducted for the following three reasons: (i) to generate enough quantities of liquid products so that their stability in various environments can be ascertained, (ii) to closely characterize the reaction products, so that individual atomic mass balances can be performed, and (iii) to determine the reproducibility of the experiments conducted. The stability of liquid products was characterized by determining their solubility in pentane and benzene. Exposure of the coal- and coal+lignin-derived liquids to air at 40 and 80°C led to a decrease in the pentane-soluble and asphaltene fractions with a concomitant enhancement in the benzene insoluble fraction. However, relatively no degradation was observed for the liquid samples exposed to an inert (N_2) atmosphere. Preliminary data show that the coal+lignin-derived liquids are more stable than that obtained by coal liquefaction. In this quarterly report, individual atomic mass balances on various experiments conducted with coal, lignin and coal+lignin mixtures are also reported. Although the overall mass recoveries of 95–98% of the total mass charged to the reactor were obtained, the atomic mass balance data are somewhat difficult to interpret due to the possible incorporation of tetralin (solvent) in the reaction products.

2568 (ETDE-mf–93728742) **Investigations specific to fuels on East German brown coal from open cast mining at Reichwalde.** Gade, U.; Piekos, S. RWE Energie AG, Essen (Germany); Bundesministerium fuer Forschung und Technologie, Bonn (Germany). [1992] 14p. (In German). Contract BMFT 30EI0050. Order Number DE93728742. Source: OSTI; NTIS (US Sales Only).

The investigations carried out make it possible to make statements on the combustion behaviour of brown coal from open cast mining at Reichwalde - South. According to these, one would not expect any increased burn-up problems. The burn-up behaviour differs only slightly from that of other east German brown coals. Due to the coal quality development which has become clear in the last

year, one would expect that the slagging rate of the boilers would increase further if coal with a total sulphur content of more than 2% (free of water) is used. In addition, there is the possibility that there would be great short-term slagging due to the pyrites nests contained in cutting above the track level. Looking at the long-term perspective (after the year 2000), when mining the Reichwalde North field, one would expect a considerable slagging problem due to the high pyrites sulphur content of about 2.5%. (orig.).

2569 (FE-MIT–89773-9) **Coal plasticity at high heating rates and temperatures: Ninth technical progress report second quarter, April 1, 1992–June 30, 1992.** Gerjarusak, S.; Peters, W.A.; Howard, J.B. Massachusetts Inst. of Tech., Cambridge, MA (United States). Sep 1992. 16p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG22-89PC89773. Order Number DE93002947. Source: OSTI; NTIS; GPO Dep.

Effects of pressure, temperature, and coal type on coal plasticity were investigated. Seven coals, from the Argonne premium sample bank ranging from lignite to low volatile bituminous, were studied. Elevated pressures, up to 10 atm of helium, did not affect coal plasticity, but reducing pressure from atmosphere to vacuum resulted in diminished plasticity, i.e. a shorter plastic period and a higher minimum apparent viscosity. It is hypothesized that high pressure inhibits mass transport of metaplast to tar vapors, but also favors metaplast repolymerization into coke and char. Higher holding temperature decreased the coal plastic period. It is hypothesized that higher temperature increases mass transport of liquid metaplast to tar vapors and metaplast repolymerization to coke and char. Heating rate had essentially no effect on the individual softening temperatures of five different plastic coals. Possible explanations are that, depending on coal type, metaplast generation, by chemical bond breaking or physical melting, or both, is not strongly affected by heating rate. In particular, for medium and low volatile bituminous cools, there is evidence that generation of the metaplast responsible for initial softening involves largely chemical bond breaking as opposed to physical melting.

0108 Waste Management

Refer also to citation(s) 2519, 2976

2570 (CONF-9109358–, pp. 23) **Environmental aspects of coal mining wastes deposition and use.** Twardowska, Irena (Polish Academy of Sciences (Poland)). USDOE, Washington, DC (United States). [1991]. From 8. international conference on chemistry for protection of the environment; Lublin (Poland); 16-18 Sep 1991. In *Chemistry for protection of the environment, Eight international conference: Proceedings.* 635p. Order Number DE92014317. Source: OSTI; NTIS; INIS.

Increasing amounts of coal mining wastes deposited at tips, as well as an extending range of minestone applications as a common fill and civil earthworks material, brings about a necessity of reliable prognosis of the environmental impact of these constructions. The extensive laboratory, lysimetric and field studies on the pollutant generation and transport in coal mine spoils form the different stratigraphic series of the Upper Silesiam coal basin (USCB) in Poland have shown that the extent of contamination and corrosive properties of minestone depends upon the balance between acid generation and buffering capacities. Moreover, it has been found that weathered buffered minestone displays a considerable sorption capacity with respect to heavy metals either in cationic or anionic form, as well as to organic matter and color. Regarding substantial binding properties, this material under certain conditions can be used as an effective protection barrier against migration of pollutant loads to the aquatic environment. Thus, the adequate assessment of minestone pollution potential or its barrier properties depends upon the relevant estimation of susceptibility of the material to acidification. For characterization of this property, the sulfide reactivity as a function of rock position in the lithostratigraphic section of the USCB, as well as the mechanism of buffering as an interaction of acidity, exchangeable cations and calcium/magnesium carbonates has been examined and discussed. The susceptibility of coal mining waste material to generate low pH values has been evaluated both experimentally and using a developed identification computer program LHI-PHREEQE.

0109 Environmental Aspects

Refer also to citation(s) 2570, 3686, 3687, 3690, 3691, 3692, 3694, 3695, 3698, 3705, 3716, 3717, 3718, 3723, 3726, 3727, 3728, 3732, 3733, 4134, 4380

2571 (INIS-mf–14085, pp. 73-85) **Present and historical environmental problems of lignite mining with special consideration of the central region of Germany.** Eissmann, L. (Leipzig Univ. (Germany)). GSF - Forschungszentrum fuer Umwelt und Gesundheit GmbH, Neuherberg (Germany). May 1992. 144p. (In German). (CONF-9112144–: Press seminar of the GSF Project 'Information Environment', Berlin (Germany), 3-4 Dec 1991). In *Current environmental situation in the new Federal States. Pt. 1.* Order Number DE93728679. Source: OSTI; NTIS (US Sales Only).

Lignite mining which dates back to the second half of the 17th century is carried out, as span-cast activity only (underground mining in the past). For mass material like lignite mining is economically most efficient - also with respect to site exploitation - but also the most destructive method for the landscape. This is an interference whose effects are irreversible for millions of years and therfore acquires a geological dimensions. The organised structure of strata lgnite- and ice age depostits on top of the lignite seams is being transformed into a mix of more or less unsorted. (orig./BBR).

2572 (ORNL/TM–12087) **Comparative study of combustion product emissions of Pakistani coal briquettes and traditional Pakistani domestic fuels.** Wachter, E.A. (Oak Ridge National Lab., TN (United States)); Gammage, R.B.; Haas, J.W. III; Wilson, D.L.; DePriest, J.C.; Wade, J.; Ahmad, N.; Sibtain, F.; Zahid Raza, M. Oak Ridge National Lab., TN (United States). Oct 1992. 26p. Sponsored by USDOE, Washington, DC (United States); Agency for International Development, Washington, DC (United States). DOE Contract AC05-84OR21400. Order Number DE93002356. Source: OSTI; NTIS; INIS; GPO Dep.

A comparative emissions study was conducted on combustion products of various solid domestic cooking fuels; the objective was to compare relative levels of organic and inorganic toxic emissions from traditional Pakistani fuels (wood, wood charcoal, and dried animal dung) with manufactured low-rank coal briquettes (Lakhra and Sor- Range coals) under conditions simulating domestic cooking. A small combustion shed 12 m^3 internal volume, air exchange rate 14 h^{-1} was used to simulate south Asian cooking rooms. 200-g charges of the various fuels were ignited in an Angethi stove located inside the shed, then combusted to completion; effluents from this combustion were monitored as a function of time. Measurements were made of respirable particulates, volatile and semi-volatile organics, CO, SO_2, and NO_x. Overall it appears that emissions from coal briquettes containing combustion amendments (slaked lime, clay, and potassium nitrate oxidizer) are no greater than emissions from traditional fuels, and in some cases are significantly lower; generally, emissions are highest for all fuels in the early stages of combustion.

0120 Mining

2573 (DOE/EIA–0118(91)) **Coal production, 1991.** USDOE Energy Information Administration, Washington, DC (United States). Office of Coal, Nuclear, Electric and Alternate Fuels. Oct 1992. 105p. Sponsored by USDOE, Washington, DC (United States). Order Number DE93003220. Source: OSTI; NTIS; GPO; INIS; GPO Dep.

Coal production in the United States in 1991 declined to a total of 996 million short tons, ending the 6-year upward trend in coal production that began in 1985. The 1991 figure is 33 million short tons below the record level of 1.029 billion short tons produced in 1990 (Table 1). Tables 2 through 33 in this report include data from mining operations that produced, prepared, and processed 10,000 or more short tons during the year. These mines yielded 993 million short tons, or 99.7 percent of the total coal production in 1991, and their summary statistics are discussed below. The majority of US coal (587 million short tons) was produced by surface mining (Table 2). Over half of all US surface mine production occurred in the Western Region, though the 60 surface mines in this area accounted for only 5 percent of the total US surface mines. The high

share of production was due to the very large surface mines in Wyoming, Texas and Montana. Nearly three quarters of underground production was in the Appalachian Region, which accounted for 92 percent of underground mines. Continuous mining methods produced the most coal among those underground operations that responded. Of the 406 million short tons, 59 percent (239 million short tons) was produced by continuous mining methods, followed by longwall (29 percent, or 119 million short tons), and conventional methods (11 percent, or 46 million short tons).

0140 Combustion

Refer also to citation(s) 2553, 2960, 2964, 2967

2574 (DOE/MC/24012–3100) **The fate of alkali species in advanced coal conversion systems: Final report.** Krishnan, G.N.; Wood, B.J. SRI International, Menlo Park, CA (United States). Nov 1991. 100p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC21-87MC24012. Order Number DE93003363. Source: OSTI; NTIS; GPO Dep.

The fate of species during coal combustion and gasification was determined experimentally in a fluidized bed reactor. A molecular-beam sampling mags spectrometer was used to identify and measure the concentration of vapor phase sodium species in the high temperature environment. Concurrent collection and analysis of the ash established the distribution of sodium species between gas-entrained and residual ash fractions. Two coals, Beulah Zap lignite and Illinois No. 6 bituminous, were used under combustion and gasification conditions at atmospheric pressure. Steady-state bed temperatures were in the range 800–950°C. An extensive calibration procedure ensured that the mass spectrometer was capable of detecting sodium-containing vapor species at concentrations as low as 50 ppb. In the temperature range 800° to 950°C, the concentrations of vapor phase sodium species (Na, Na_2O, NaCl, and Na_2SO_4) are less than 0.05 ppm under combustion conditions with excess air. However, under gasification conditions with Beulah Zap lignite, sodium vapor species are present at about 14 ppm at a temperature of 820°. Of this amount, NaCl vapor constitutes about 5 ppm and the rest is very likely NAOH. Sodium in the form of NaCl in coal enhances the vaporization of sodium species during combustion. Vapor phase concentration of both NaCl and Na_2SO_4 increased when NaCl was added to the Beulah Zap lignite. Ash particles account for nearly 100% of the sodium in the coal during combustion in the investigated temperature range. The fine fly-ash particles (<10 μm) are enriched in sodium, mainly in the form of sodium sulfate. The amount of sodium species in this ash fraction may be as high as 30 wt % of the total sodium. Sodium in the coarse ash particle phase retained in the bed is mainly in amorphous forms.

2575 (DOE/MC/24132–92/C0079) **Second year operation of the Tidd PFBC Demonstration Plant.** Bauer, D.A.; Stogran, H.K. Ohio Power Co., Columbus, OH (United States). [1992]. 7p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FC21-87MC24132. (CONF-921037–6: 9. annual international Pittsburgh coal conference, Pittsburgh, PA (United States), 12-16 Oct 1992). Order Number DE93002152. Source: OSTI; NTIS; GPO Dep.

The Tidd PFBC Demonstration Plant is the first utility-scale PFBC demonstration project in the United States. Its objective is to demonstrate that the pressurized fluidized bed combustion (PFBC) combined-cycle technology is a cost effective, reliable, and environmentally acceptable alternative to conventional coal fired electric power generation using flue gas desulfurization. The project will demonstrate PFBC technology on a large scale for use in commercial combined-cycle electric generating plants. The program will demonstrate has turbine survivability and controllability; process performance in removing oxides of sulfur and minimizing the formation of oxides of nitrogen; equipment and system performance and reliability. This paper reviews problems encountered during the first year of unit operation, the modifications made during an outage in the Fall of 1991 to correct these problems, and the post outage operating experiences through July 1992.

2576 (DOE/MC/24207–2997) **Experimental study of the hydrodynamics and cluster formation in a Circulating Fluidized Bed: Annual report, 1990.** Gautam, M.; Johnson, E. West Virginia Univ., Morgantown, WV (United States). Dept. of Mechanical and Aerospace Engineering. Jan 1991. 127p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FC21-87MC24207. Order Number DE91002078. Source: OSTI; NTIS; GPO Dep.

A novel non-invasive gas-solid flow measuring technique being developed and tested for studying the hydrodynamics inside the riser of a Circulating Fluidized Bed (CFB). First of the two aims of the overall program, namely, design, development and testing of the technique to characterize the particle and gas velocities in two-phase flows was accomplished in the past year. The "fringe-model" laser Doppler anemometry concept has been modified and extended by using particles coated with a fluorescent dye and introducing a narrow band pass filter in the receiving optics. The technique permits optical discrimination between the scattered light (laser wavelength from undyed particles) and the fluorescence emission (longer wavelength). Results from extensive testing of various dye-solvent combinations, counter processor settings, signal-to noise optimization and subsequent flow measurements in the test section have shown that the technique can effectively discriminate between two classes of particles–the smaller seed particles for the gas phase data and the larger bed particles. Use of a two-watt Argon-Ion laser assisted in the non-intrusive probing of the gas-solid flow and in enhancing the signal-to-noise ratio. An uncertainty analysis of LDA measurements is presented. Design of the cold flow CFB model, presently under fabrication, is outlined in this report. The Plexiglas CFB model will be employed for the riser core-annular flow studies using the fluorescence-emission based laser-Doppler anemometry. The results from this study will present a unique detailed description of the complex gas-solid behavior in the CFB riser.

2577 (DOE/METC/C–93/7032) **The US Department of Energy perspective on pressurized fluidized bed combustion.** Dellefield, R.J.; Reed, M.E. USDOE Morgantown Energy Technology Center, WV (United States). [1992]. 17p. Sponsored by USDOE, Washington, DC (United States). (CONF-9209201–2: Application of fluidized-bed comubstion for power generation utility conference, Boston, MA (United States), 23-25 Sep 1992). Order Number DE93001378. Source: OSTI; NTIS; GPO Dep.

The Department of Energy (DOE) has been intimately involved in the development of coal combustion using pressurized fluidized beds since the 1970s. This paper presents the reasons why the DOE is pursuing the development and commercialization of Pressurized Fluidized Bed Combustion (PFBC) systems. First generation PFBC technology is nearing commercial deployment and the ongoing demonstrations as part of DOE's Clean Coal Technology (CCT) program will enable the technology to be a low-risk, environmentally acceptable option for utilities. Further improvements in environmental and thermal performance will be required to maintain PFBC technology as a competitive option to gasification-based power systems in the 2000s. The cost of electricity, capital costs, emissions, and thermal efficiency of PFBC systems compared to alternatives are covered. A snapshot of the development activities planned for Advanced PFBC systems, which the DOE considers necessary to develop utility-sized, Advanced PFBC combined-cycle plants, are discussed. These development activities include Advanced PFBC component development tests with the Foster Wheeler Development Corporation and the creation of a Power Systems Development Facility to provide an integrated Advanced PFBC module at Wilsonville, Alabama.

2578 (DOE/PC/79660–T5) **Advanced Vortexing Combustor (VC) for space/water heating applications (proof-of-concept model development): Technical progress report No. 1.** Fu, T.T. Naval Civil Engineering Lab., Port Hueneme, CA (United States). Dept. of Energy and Environment. Mar 1988. 15p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AI22-87PC79660. Order Number DE93003880. Source: OSTI; NTIS; GPO Dep.

The Naval Civil Engineering Laboratory is developing a proof-of-concept Vortexing Combustor (VC) with 2–4 MMBtu/hr firing capacity to burn both coal-water fuel and ultrafine coal for boiler

applications. Thermodynamic analysis was made to trade off design features of the combustor. Results indicated that for best thermal efficiency, consistent with the low temperature combustion requirements, a sub-adiabatic VC arrangement should be selected. In order to minimize the risk of uncertainties, a three-step approach was chosen by which two small size models (0.15 and 0.6 MMBtu/hr) will be designed, built, and tested. The full-scale, proof-of-concept model will then be designed based on the results of tests using the small-scale models. Extensive testing of the full-scale model will be conducted to prove the concept. All combustors will be designed based on the use of one type of coal-water fuel. Ultrafine coal will be tested and regarded as a variance. The design and construction of the 0.15 MMBtu/hr model has been completed and it is being assembled for exploratory testing of the VC concept. Several major pieces of equipment, purchased with NCEL funds as a part of the cost sharing effort have arrived. The overall project has been progressing well and is on schedule. Hot testing of the 0.15 MMBtu/hr model will take place in the March–June time frame.

2579 (DOE/PC/79660–T6) **Development of a vortexing combustor (VC) for space/water heating applications (proof-of-concept model development): Technical progress report No. 2, 1 February–30 April 1988.** Fu, T.T. Naval Civil Engineering Lab., Port Hueneme, CA (United States). Dept. of Energy and Environment. Jun 1988. 12p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AI22-87PC79660. Order Number DE93002681. Source: OSTI; NTIS; GPO Dep.

This is the second Technical Progress Report for DE-AI22-87PC79660 covering the period 1 February to 30 April 1988. Our main effort during this reporting period is to use the 0.15 MB/H exploratory vortexing combustor hot model as a tool to develop information leading toward the proof-of-concept model design. This 0.15 MB/H model has been operational and performs satisfactorily in firing ultrafine coal. To date, about 50 hours of running time has been logged and about 500 pounds of ultrafine coal has been consumed without incident. The longest uninterrupted, stable running duration was 11 hours. The starting procedure is simple. Once the combustor is started the flame is self sustaining and no supplemental fuel is needed. The fuel to the combustor can be shut off for as long as one-half hour and restarted by simply blowing in the coal. Up to 0.18 MB/H firing rate has been achieved. Future efforts consist of: Conducting more exploratory experimentation using the 0.15 MB/H model, adding its capability to fire coal water fuel, design of the 0.6 MB/H model, and building up laboratory capability for testing larger models.

2580 (DOE/PC/79660–T7) **Development of a Vortexing Combustor (VC) for space/water heating applications (proof-of-concept model development): Technical progress report No. 3.** Fu, T.T. Naval Civil Engineering Lab., Port Hueneme, CA (United States). Dept. of Energy and Environment. Sep 1988. 11p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AI22-87PC79660. Order Number DE93004031. Source: OSTI; NTIS; GPO Dep.

This in the third quarterly technical progress report for DE-AI2287PC79660 covering the period between 1 May and 31 July 1988. During this reporting period, the firing test of Dry Ultrafine Coal (DUC) in the 0.15 MB/H exploratory model has continued. Sufficient experience and insight have been accumulated to help finalize the design of the 0.6 MB/H experimental model. Fabrication of the 0.6 MB/H model in 33% complete. A Coal-Water Fuel (CWF) loop for firing tests and an apparatus for testing CWF nozzle spray patterns are also 33% complete. A now test facility which includes the flue gas cleaning facility (described in our first quarterly progress report) is operational. We are now able to conduct independent tests on both the 0.15 and 0.6 MB/H models without disruption to either model. Current efforts have been concentrated in permanently installing test apparatus/equipment in the now test facility area. CWF tests in the 0. 15 MB/H model and DUC tests in the 0. 6 MB/H model are expected to begin in September 1988.

2581 (DOE/PC/79660–T8) **Development of a Vortex Combustor (VC) for space/water heating applications (proof-of-concept model development): Technical progress report No. 4.** Fu, T.T. Naval Civil Engineering Lab., Port Hueneme, CA (United States). Dept. of Energy and Environment. Jan 1989. 16p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AI22-87PC79660. Order Number DE93004032. Source: OSTI; NTIS; GPO Dep.

Based on the results and experience gained from the exploratory model tests, a 0.6 MB/H experimental model has been designed and the construction is nearly complete. This model incorporates a variable (cooling surface area) center heat removal unit and flexible air flow rate and velocity controls. It is also readily convertible to an outside heat removal arrangement for capacity increase. Suitable instrumentation will be installed obtaining quantitative data for finalizing the design of the proof-of-concept model. Tests will begin early in December 1988. Design of the proof-of-concept model is expected to be ready for Preliminary Design Review early in 1989.

2582 (DOE/PC/79660–T9) **Development of a vortex combustor (VC) for space/water heating applications (proof-of-concept model development): Technical progress report No. 6, [1 February 1989–30 April 1989].** Fu, T.T. Naval Civil Engineering Lab., Port Hueneme, CA (United States). Dept. of Energy and Environment. Jun 1989. 11p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AI22-87PC79660. Order Number DE93004033. Source: OSTI; NTIS; GPO Dep.

This is the sixth quarterly Technical Progress Report for the development of a proof-of-concept vortex combustor under interagency agreement DE-AI22-87PC79660 covering the period between 1 February 1989 and 30 April 1989. The Vortex Combustor (VC) under development here is a device to burn either Dry Ultrafine Coal (DUC) or Coal-Water Fuel (CWF) in a high swirl and low temperature environment. Being a new concept technical data relevant to the design of the proof-of-concept model is practically nonexistent. In order to minimize the risk of uncertainties, sufficient basic design data must be generated first. To achieve this, two subscale models have been built: A 0.15 MB/H exploratory model and a 0.6 MB/H experimental model. A proof-of-concept (POC) model will then be designed and built for demonstrating the concept. Work on the exploratory model has been completed and reported in our fifth quarterly technical progress report. It will be reported also in a separate topical report. During this reporting period, preparations for testing the experimental model have been completed and the setup satisfactorily shakedown tented. The design of POC model has been approved. The results are summarized in this report.

2583 (DOE/PC/89774–T5) **Effects of catalytic mineral matter on CO/CO_2 temperature and burning time for char combustion: Quarterly progress report No. 11, April–June 1992.** Longwell, J.P.; Sarofim, A.F.; Lee, C.H. Massachusetts Inst. of Tech., Cambridge, MA (United States). Dept. of Chemical Engineering. [1992]. 31p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG22-89PC89774. Order Number DE92041297. Source: OSTI; NTIS; GPO Dep.

The high temperature oxidation of char is of interest in a number of applications in which coal must be burned in confined spaces. These include: the conversion of oil-fired boilers to coal using coal-water slurries, the development of a new generation of pulverized-coal-fired cyclone burners, the injection of coal into the tuyeres of blast furnaces, the use of coal as a fuel in direct-fired gas turbines in large-bore low-speed diesels, and entrained flow gasifiers. In addition, there is a need to better understand the temperature history of char particles in conventional pulverized-coal-fired boilers in order to better understand the processes governing the formation of pollutants and the transformation of mineral matter. The temperature of a char particle burning in an oxygen containing atmosphere is the product of a strongly coupled balance between particle size and physical properties, heat transfer from the particle, surface reactivity, CO/CO_2 ratio and gas phase diffusion in the surrounding boundary layer and within the particle. In addition to its effects on burning rate, particle temperature has major effects on ash proper-ties and mineral matter vaporization. Measurements of the temperature of individual burning char particles have become available in recent years and have clearly demonstrated large particle to particle temperature variations which depend strongly on particle size and on panicle composition. These studies, done with pulverized coal, do not allow direct determination of the CO/CO_2 ratio produced at the char surface or the catalytic effects of mineral matter in the individual char particles

and it has generally been assumed that CO is the only product of the carbon-oxygen reaction and that CO_2 is formed by subsequent gas phase reaction More recent work, however, has pointed out the need to take CO_2 Production into consideration in order to account for observed particle temperatures.

2584 (DOE/PC/89776–T10) **Effects of calcium magnesium acetate on the combustion of coal-water slurries: Twelfth quarterly project status report, 1 June 1992–31 August 1992.** Levendis, Y.A. Northeastern Univ., Boston, MA (United States). [1992]. 11p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG22-89PC89776. Order Number DE93004940. Source: OSTI; NTIS; GPO Dep.

The general objective of the project is to investigate the combustion behavior of single and multiple Coal-Water Fuel (CWF) particles burning at high temperature environments. Both uncatalyzed as well as catalyzed CWF drops with Calcium Magnesium Acetate (CMA)- catalyst will be studied. Emphasis will also be given in the effects of CMA on the sulfur capture during combustion. To help achieve these objectives the following project tasks were carried over this 11th three-month period. Work on three major tasks was conducted over this period: (a) We obtained a larger inventory of pyrometric and cinematographic observations on single CWF particles of micronized coal, with and without CMA, burning in various O_2 Partial pressures and wall temperatures. (b) Preliminary reaction rate calculations were completed using simplified models. (c) Work has been started on optimizing and running a computer program that performs detailed calculation of reaction rates. (d) Development work on the new single drop generator has continued. (e) A new laboratory space has been prepared and assigned to this project.

2585 (DOE/PC/90756–T5) **Research on thermophoretic and inertial aspects of the ash particle deposition on heat exchanger surfaces in coal-fired equipment: Quarterly technical report, September 1, 1986–November 30, 1986.** Rosner, D.E. Yale Univ., New Haven, CT (United States). High Temperature Chemical Reaction Engineering Lab. Dec 1986. 8p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG22-86PC90756. Order Number DE93003892. Source: OSTI; NTIS; GPO Dep.

In support of the above mentioned objectives, we have initiated theoretical studies in the following three interrelated areas : (a) Interaction of inertial- and thermophoretic effects in well-defined laminar "dusty-gas" flows. (b) Self-regulated sticking and deposit erosion in the simultaneous presence of vapor or submicron "glue" (c) Use of packed bed and tube-bank heat transfer and friction correlations to provide the basis for future tube-bank fouling predictions.During the first three months of Grant DE-FG22-86 PC 90756, we have: (1) Designed and initiated construction of the microcombustor particle-laden jet facility described in Section 3.1. (2) Initiated theoretical studies of the interaction of inertial and thermophoretic effects, the role of simultaneous vapor arrival in determining particle sticking and erosion probabilities, and mass transport phenomena in deep tube banks.

2586 (DOE/PC/90756–T6) **Research on thermophoretic and inertial aspects of ash particle deposition on heat exchanger surfaces in coal-fired equipment: Quarterly technical report, December 1, 1986–February 28, 1987.** Rosner, D.E. Yale Univ., New Haven, CT (United States). High Temperature Chemical Reaction Engineering Lab. Mar 1987. 8p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG22-86PC90756. Order Number DE93003893. Source: OSTI; NTIS; GPO Dep.

In support of the above mentioned objectives, we are carrying out theoretical studies in the following three interrelated areas: (a) Interaction of inertial- and thermophoretic effects in well-defined laminar "dusty-gas" flows; (b) Self-regulated sticking and deposit erosion in the simultaneous presence of vapor or submicron "glue"; (c) Use of packed bed and tube-bank heat transfer and friction correlations to provide the basis for future tube-bank fouling predictions. During this second quarter of Grant DE-FG22-86 PC 90756. we have: (1) done preliminary gas velocity and temperature calibrations of the micro-combustor exit gas flow jet and initiated the development of both a monodispersed droplet feed system and powder feed system to provide monodispersed particle laden jets covering a broad spectrum of particle sizes (ca. 0.5–50 m diameter); and, (2) demonstrated the ability of impacting supermicron particles to remove predeposited submicron particles on a platinum target, using real-time optical reflectivity methods. These preliminary experiments will be extended and discussed in our next Quarterly Technical Report.

2587 (DOE/PC/90756–T7) **Research on thermophoretic and inertial aspects of ash particle deposition on heat exchanger surfaces in coal-fired equipment: Quarterly technical report No. 3, March 1, 1987–May 31, 1987.** Rosner, D.E. Yale Univ., New Haven, CT (United States). High Temperature Chemical Reaction Engineering Lab. Jun 1987. 9p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG22-86PC90756. Order Number DE93003894. Source: OSTI; NTIS; GPO Dep.

During this third quarter of Grant DE-FG22-86 PC 90756, we have obtained preliminary experimental results on the deposition behavior of submicron and supermicron solid particles (MgO, Al_2O_3) on a two-dimensional surface exposed to a high temperature/velocity particle "laden" atmospheric pressure jet. The uniform velocity ("plug flow") jet, with temperatures up to about 1520 K, derives from a pressurized gaseous fuel microcombustion chamber (110 cc) equipped with a platinum guiding (exit) channel. Particles were generated by several methods (Berglund-Liu type aerosol generator, ultrasonic nebulizer, or syringe feeder with aerodynamic particle off-take) and were introduced into the combustion chamber with a carrier stream of nitrogen or air. Laser light scattering and reflectivity techniques were used for the study of particle deposition, supplemented by post-mortem microscopy on the exposed surface. We observed a linear deposition rate of submicron particles due to the thermophoretic mechanism (until the first layer was developed) under both high and low velocity conditions. On the contrary, supermicron particle deposits reach a steady-state, evidently due to a dynamic equilibrium between particle deposition and dislodging caused by the impacting particles. At several temperatures particle-free subsonic gas jets (up to 120 m/sec) were unable to remove the submicron particle layer.

2588 (DOE/PC/90756–T8) **Research on thermophoretic and inertial aspects of ash particle deposition on heat exchanger surfaces in coal-fired equipment: Quarterly technical report No. 6, December 1, 1987–February 28, 1988.** Rosner, D.E. Yale Univ., New Haven, CT (United States). High Temperature Chemical Reaction Engineering Lab. Mar 1988. 8p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG22-86PC90756. Order Number DE93003895. Source: OSTI; NTIS; GPO Dep.

During the present reporting period, we have initiated work on (a) the interpretation of our recent data (see QTR5) on deposition rates under the simultaneous influence of inertia and thermophoresis, (b) the possible rate of particle photophoresis in environments characterized by high radiative heat loads. and (c) the influence of particle size distributions on total mass deposition rates. The fruits of these initiatives will be reported in subsequent quarterly technical reports. Here, we focus on our recent theoretical results in the important but previously uncharted area of the relations between particulate deposition mechanisms, deposit microstructure and deposit properties. Experimental verification of some of the most interesting predictions will be the subject of future HTCRE-Lab studies. Recent discussions with fouling engineers have convinced us that despite recent advances in our ability to predict particle deposition rates in convective-diffusion environments, the important connection between resulting deposit properties (effective thermal conductivity permeability, ···) and deposition mechanism remain poorly understood and only scarcely studied. Accordingly, as part of this DOE-PETC program we have developed a discrete stochastic model to simulate particulate deposition processes resulting from a combination of deposition mechanisms.

2589 (DOE/PC/90756–T10) **Research on thermophoretic and inertial aspects of ash particle deposition on heat exchanger surfaces in coal-fired equipment: Quarterly report No. 9, September 1, 1988–November 30, 1988.** Rosner, D.E. Yale Univ., New Haven, CT (United States). High Temperature Chemical Reaction Engineering Lab. Dec 1988. 12p. Sponsored by USDOE,

Washington, DC (United States). DOE Contract FG22-86PC90756. Order Number DE93003897. Source: OSTI; NTIS; GPO Dep.

A real-time laser light-reflectivity technique is being used to study simultaneous thermophoretic and inertial influences on the deposition behavior of MgO particles produced via ultrasonic nebulization (submicrometer range). The deposition surface (a concave platinum ribbon) is exposed to a high velocity/temperature jet of alkali sulfate-free combustion products exiting from a seeded (C_3H_8/air) microcombustor (110 cm^3). The reflectivity data were calibrated against deposition rates obtained from SEM pictures of the target, and were normalized with the nominal particle feed rate, in order to obtain the mass transfer Stanton number, St_m, trends depicted in Figure 1. For the submicron (ca. 0.7μm) particles inertial effects appear to set in at Stokes (Stk) numbers of $O(10^{-2})$ (an order of magnitude lower than the ones needed for "pure" inertial impaction), affecting significantly the dominant thermophoretic deposition mechanism. A first order (in Stk) theoretical analysis of the problem in which particle inertia is treated as equivalent to "pressure diffusion," cannot explain the observed dependence of the deposition rate on Stk. We are presently formulating a Lagrangian approach, valid for all values of Stk, in order to interpret these data. In addition, a Single Particle Counter (SPC) and Transit Time Velocimeter (TTV), are being developed, to allow more precise measurements of particle feed rates and velocities.

2590 (DOE/PC/90756–T11) **Research on thermophoretic and inertial aspects of ash particle deposition on heat exchanger surfaces in coal-fired equipment: Quarterly technical report No. 10, December 1, 1988–February 28, 1989.** Rosner, D.E. Yale Univ., New Haven, CT (United States). High Temperature Chemical Reaction Engineering Lab. Mar 1989. 11p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG22-86PC90756. Order Number DE93003898. Source: OSTI; NTIS; GPO Dep.

Little is yet known (theoretically or experimentally) about the simultaneous effects of particle inertia, particle thermophoresis and high mass loading on the important engineering problem of predicting deposition rates from flowing "dusty" gases. For this reason, we investigate the motion of particles present at nonnegligible mass loading in a flowing nonisothermal gaseous medium and their deposition on strongly cooled or heated solid objects by examining the instructive case of steady axisymmetric "dusty gas" flow between two infinite disks: an inlet (porous) disk and the impermeable "target" disk – a flow not unlike that encountered in recent seeded-flame experiments. Since this stagnation flow/geometry admits interesting self-similar solutions at all Reynolds numbers, we are able to predict laminar flow mass-, momentum- and energy-transfer rate coefficients over a wide range of particle mass loadings, dimensionless particle relaxation times (Stokes numbers), dimensionless thermophoretic diffusivities, and gas Reynolds numbers. As a by-product, we illustrate the accuracy and possible improvement of our previous "diffusion model" for tightly coupled dusty gas systems. Moreover, we report new results illustrating the dependence of the important "critical" Stokes number (for incipient particle impaction) on particle mass loading and wall/gas temperature ratio for dust-laden gas motion towards "overheated" solid surfaces. The present formulation and insulating transport coefficients should not only be useful in explaining/predicting recent deposition rate trends in "seeded" flame experiments, but also highly mass-loaded systems of technological interest.

2591 (DOE/PC/90756–T12) **Research on thermophoretic and inertial aspects of ash particle deposition on heat exchanger surfaces in coal-fired equipment: Quarterly technical report No. 11, March 1, 1989–May 31, 1989.** Rosner, D.E. Yale Univ., New Haven, CT (United States). High Temperature Chemical Reaction Engineering Lab. Jun 1989. 10p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG22-86PC90756. Order Number DE93003899. Source: OSTI; NTIS; GPO Dep.

Our results on photophoresis reveal significant transport effects, mainly for particles which are carbonaceous (char-like, soot-like) rather than ash-like. Figure 2 shows the predicted dimensionless transport coefficient (proportional to the ordinary Stanton number for mass transfer) as a function of radiation/convective flux ratio and carbonaceous particle radius for laminar boundary layer flow past a wall cooled to 70% of the mainstream temperature, subjected to a radiative energy spectrum appropriate to a black-body source at ca. 1800K. One sees that large effects on the particle deposition rate are produced if the radiative flux is comparable to or exceeds the ordinary (Fourier) energy flux. We are now extending this work to include the effects of inevitable particle asymmetries, including agglomerate (shape) effects, and the role that energy transfer (eg. radiative cooling of larger particles in a population) might play in the coagulation dynamics and deposition dynamics of such aerosol populations.

2592 (DOE/PC/91307–T5) **Coal combustion: Effect of process conditions on char reactivity: Fourth quarterly technical report, June 1, 1992–September 1, 1992.** Zygourakis, K. Rice Univ., Houston, TX (United States). Dept. of Chemical Engineering. [1992]. 16p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG22-91PC91307. Order Number DE93004926. Source: OSTI; NTIS; GPO Dep.

During the past quarter, we systematically investigated the effects of particle size, pyrolysis heating rate, and heat treatment temperature on the reactivity of chars. The results show that pyrolysis heating rates or particle size do not affect the reactivity of chars in the kinetic control regime (420°C). High heat treatment temperatures (HTT) slightly lowered the char intrinsic reactivities. When the char particles were reacted in the regime of diffusional limitations (625°C), a significant effect of particle size was detected. We observed that decreasing final heat treatment temperatures resulted in small increases of the intrinsic reactivity for the smallest particles. For the largest particles, however, the effect of decreasing HTT was dramatic. By lowering the HTT from 775 to 625°C, the reactivity of chars at 625°C increased by a factor of 6 for chars produced from 20–25 mesh coal particles. Finally, the shape of the reactivity patterns changed significantly as we moved from the regime of kinetic control to the regime of intraparticle diffusional limitations.

2593 (DOE/PC/91308–4) **Particulate behavior in a controlled-profile pulverized coal-Fired reactor: A study of coupled turbulent particle dispersion and thermal radiation transport: Quarterly technical progress report, June 15, 1992–September 14, 1992.** Queiroz, M.; Webb, B.W. Brigham Young Univ., Provo, UT (United States). [1992]. 4p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG22-91PC91308. Order Number DE93003095. Source: OSTI; NTIS; GPO Dep.

During the fourth quarter progress has been made in the following areas: preparation for reactor refurbishment, instrumentation development, coal acquisition for experimental tests, and radiation and particle dispersion modelling. Refurbishment of the Controlled Profile Reactor was initiated this summer and is almost finished. Construction work for the local transmissometer probe is now completed. This laser-based instrument, combined with the data from the PCSV probe will enable estimate of the local concentration of particulate below 0.5 μm in size. Additionally, it will permit measurement of the temporal statistics of the local particulate number density.

2594 (ORNL–6718) **Fossil Energy Program semiannual progress report, October 1990–March 1991.** Judkins, R.R. Oak Ridge National Lab., TN (United States). Jul 1992. 163p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. Order Number DE93002621. Source: OSTI; NTIS; GPO Dep.

This report covers progress made during the period October 1, 1990, through March 31, 1991, for research and development projects that contribute to the advancement of various fossil energy technologies. Projects on the Fossil Energy Program are supported by the DOE Office of Fossil Energy, the DOE Morgantown Energy Technology Center, the DOE Pittsburgh Energy Technology Center, the DOE Fossil Energy Clean Coal Technology Program, the DOE Office of Basic Energy Sciences, the DOE Fossil Energy Office of Petroleum Reserves, the DOE Fossil Energy Naval Petroleum and Oil Shale Reserves, and the US Agency for International Development. The Fossil, Energy Program organization chart is shown in the appendix. Topics include: alloys, ceramics and composite research and development; corrosion and erosion research; environmental analysis and information systems; coal conversion

development; mild gasification product characterization; coal combustion research; strategic petroleum reserve planning and modeling; and coal structure and chemistry.

2595 Pulse combustor with controllable oscillations. Richards, G.A.; Morris, G.J.; Welter, M.J. To Dept. of Energy. 1991. Filed date 4 Mar 1991. USAA patent application 7-663,34. 24p. Sponsored by USDOE, Washington, DC (United States). Order Number DE93002003. Source: OSTI; NTIS; GPO Dep.

A pulse combustor having thermally induced pulse combustion in a continuously flowing system is described. The pulse combustor is fitted with at lease one elongated ceramic body which significantly increases the heat transfer area in the combustion chamber of the combustor. The ceramic body or bodies possess sufficient mass and heat capacity to ignite the fuel-air charge once the ceramic body or bodies are heated by conventional spark plug initiated combustion so as to provide repetitive ignition and combustion of sequentially introduced fuel-air charges without the assistance of the spark plug and the rapid quenching of the flame after each ignition in a controlled manner so as to provide a selective control over the oscillation frequency and amplitude. Additional control over the heat transfer in the combustion chamber is provided by employing heat exchange mechanisms for selectively heating or cooling the elongated ceramic body or bodies and/or the walls of the combustion chamber.

0150 Economic, Industrial, and Business Aspects

Refer also to citation(s) 2573

2596 (DOE/EIA–0558(91)) **Energy information sheets.** National Energy Information Center, Washington, DC (United States). Jul 1992. 42p. Sponsored by USDOE, Washington, DC (United States). Order Number DE93002215. Source: OSTI; NTIS; GPO; GPO Dep.

This document consists of two-page summaries (e.g. information sheets) characterizing the production, consumption, reserves, prices, and sales of crude oil, petroleum, coal, natural gas and electricity. It also contains information sheets on nuclear power generation, renewable energy, degree-days, and propane.

0160 Health and Safety

2597 (ETDE-mf–93728727) **Locating buried people in the underground hard coal industry. Final report.** Poetsch, J. Ruhrkohle AG, Essen (Germany); Bundesministerium fuer Forschung und Technologie, Bonn (Germany). Jan 1992 154p. (In German). Contract BMFT 01HD016. Order Number DE93728727. Source: OSTI; NTIS (US Sales Only).

At his underground workplace the miner runs the risk of 'being buried'. The exact knowledge of the location of a buried person provides for targeted optimal rescue measures. This clearly improves the survival chance of a buried person because a more rapid rescue becomes possible. Moreover the risk of the rescue teams is reduced as a result of shorter residence times in the affected excavation. The R and D project aimed at developing a person locating system suitable for use in the underground hardocoal industry. This system was to provide for accurate localisation of buried people over a minimum distance of 5 m and further developments protecting people in hazardous areas around machinery. The set targets could be achieved or even clearly exceeded with ranges of up to 14.5 m. The results of the R and D project can be transferred to the overall German hardcoal industry. Moreover, the global application of the locating system is possible as is the application in the non-hardcoal industry. The use of the locating system to secure defined hazardous areas is possible both in underground mining and the other industries if corresponding equipment securing hazardous areas tailored to the individual application is developed. (orig.).

02 PETROLEUM

0202 Reserves, Geology, and Exploration

Refer also to citation(s) 2604

2598 (DOE/EIA–0557) **Geologic distributions of US oil and gas.** USDOE Energy Information Administration, Washington, DC (United States). Office of Oil and Gas. 31 Jul 1992. 148p. Sponsored by USDOE, Washington, DC (United States). Order Number DE93002216. Source: OSTI; NTIS; INIS; GPO Dep.

This publication presents nonproprietary field size distributions that encompass most domestic oil and gas fields at year-end 1989. These data are organized by geologic provinces as defined by the American Association of Petroleum Geologists' Committee on Statistics of Drilling (AAPG/CSD), by regional geographic aggregates of the AAPG/CSD provinces, and Nationally. The report also provides partial volumetric distributions of petroleum liquid and natural gas ultimate recoveries for three macro-geologic variables: principal lithology of the reservoir rock, principal trapping condition and geologic age of the reservoir rock, The former two variables are presented Nationally and by geographic region, in more detail than has heretofore been available. The latter variable is provided Nationally at the same level of detail previously available. Eighteen tables and 66 figures present original data on domestic oil and gas occurrence. Unfortunately, volumetric data inadequacy dictated exclusion of Appalachian region oil and gas fields from the study. All other areas of the United States known to be productive of crude oil or natural gas through year-end 1989, onshore and offshore, were included. It should be noted that none of the results and conclusions would be expected to substantively differ had data for the Appalachian region been available for inclusion in the study.

2599 (DOE/ID/12839–9) **Characterization of oil and gas reservoir heterogeneity: Technical progress report, July 1, 1992–September 30, 1992.** Sharma, G.D. Alaska Univ., Fairbanks, AK (United States). Petroleum Development Lab. [1992]. 25p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG07-90ID12839. Order Number DE93003304. Source: OSTI; NTIS; GPO Dep.

The ultimate oojective of this cooperative research project is to characterize Alaskan petroleum reservoirs in terms of their reserves, physical and chemical properties, geologic configuration in relation to lithofacies and structure, and development potential. The project has two tasks: Task 1 is a geological description of the reservoirs including petrophysical properties, i.e., porosity, permeability, permeability variation, formation depth, temperature, and net pay, facies changes and reservoir structures as drawn from cores, well logs, and other geological data. Task 2 is reservoir fluid characterization–determination of physical properties of reservoir fluids including density, viscosity, phase distributions and composition as well as petrogenesis–source rock identification; and the study of asphaltene precipitation for Alaskan crude oils. This report presents a summary of technical progress of the well log analysis of Kuparuk Field, Northslope, Alaska.

2600 (NIPER–639) **[National Institute for Petroleum and Energy Research] monthly progress report, August 1992.** National Inst. for Petroleum and Energy Research, Bartlesville, OK (United States). Oct 1992. 61p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FC22-83FE60149. Order Number DE93000903. Source: OSTI; NTIS; GPO Dep.

Geological and engineering data from Patrick Draw field and Almond outcrops have been electronically formatted for the initial data base on the Almond formation. In addition, a number of research areas are identified. An annotated bibliography of selected references on barrier islands, with emphasis on Patrick Draw field, Sweetwater County, WY, has been prepared. The bibliography contains more than 200 references on barrier island systems worldwide. The results of laboratory experiments indicate that surfactant-enhanced flooding has potential use for the recovery of oil from Naval Petroleum Reserve NPR No. 3 reservoirs. Because of the highly fractured nature of these reservoirs, chemical flooding is expected to be more efficient if gels are applied to improve reservoir conformance. FY92 experiments to determine surfactant/

polymer interactions that might occur during field tests have been finalized. The results show that interactions do occur in mixtures containing both surfactant and polymer and that the interactions are characterized by inhomogeneity; however, this effect is not as severe in systems containing crude oil. Thermodynamic property measurements are now complete for the four-ring, nitrogen-containing aromatic compounds benzo[c]carbazole and benzo[c]phenanthridine. High-temperature heat capacity and critical property determinations by differential scanning calorimetry were started in August for a series of dimethylpyridines. Results of studies on the dimethylpyridines will provide a reliable basis for estimating the properties of a wide variety of substituted aromatic nitrogen compounds. Heat capacity and enthalpy measurements were completed for the four-ring naphthene compound, 5,6-dihydro-4H-benz[de]anthracene.

2601 (UCRL-ID–112038) **A chemical kinetic model of hydrocarbon generation from the Bakken Formation, Williston Basin, North Dakota.** Sweeney, J.J. (Lawrence Livermore National Lab., CA (United States)); Braun, R.L.; Burnham, A.K.; Gosnold, W.D. Lawrence Livermore National Lab., CA (United States). Oct 1992. 57p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. Order Number DE93003335. Source: OSTI; NTIS; GPO Dep.

This report describes a model of hydrocarbon generation and expulsion in the North Dakota portion of the Williston Basin. The modeling incorporates kinetic methods to simulate chemical reactions and 1-dimensional conductive heat flow models to simulate thermal histories of the Mississippian-Devonian Bakken Formation source rock. We developed thermal histories of the source rock for 53 wells in the basin using stratigraphic and heat flow data obtained by the University of North Dakota. Chemical kinetics for hydrocarbon generation, determined from Pyromat pyrolysis, were, then used with the diennal histories to calculate the present day value of the Rock-Eval T_{max} for each well. The calculated Rock-Eval T_{max} values agreed with measured values within amounts attributable to uncertainties in the chemical kinetics and the heat flow. These optimized thermal histories were then used with a more detailed chemical kinetic model of hydrocarbon generation and expulsion, modified from a model developed for the Cretaceous La Luna shale, to simulate pore pressure development and detailed aspects of the hydrocarbon chemistry. When compared to values estimated from sonic logs, the pore pressure calculation underestimates the role of hydrocarbon generation and overestimates the role of compaction disequilibrium, but it matches well the general areal extent of pore pressures of 0.7 times lithostatic and higher. The simulated chemistry agrees very well with measured values of HI, PI, H/C atomic ratio of the kerogen, and Rock-Eval S1. The model is not as successful in simulating the amount of extracted bitumen and its saturate content, suggesting that detailed hydrous pyrolysis experiments will probably be needed to further refine the chemical model.

2602 (UCRL-JC–109621) **Heterogeneity and vapor extraction performance.** Chesnut, D.A. Lawrence Livermore National Lab., CA (United States). Aug 1992. 58p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. (CONF-920808–12: American Institute of Chemical Engineers (AIChE) summer national meeting, Minneapolis, MN (United States), 9-12 Aug 1992). Order Number DE93001316. Source: OSTI; NTIS; GPO Dep.

Soil venting or vapor extraction, the "pump and treat" method of aquifer remediation, and petroleum production by primary or secondary recovery all involve the flow of fluids of varying composition in porous geologic media. Properties of these media which govern fluid flow and contaminant transport, such as porosity, permeability, mineralogy, saturations, and solute concentration, vary from point to point, often by orders of magnitude. As this spatial heterogeneity increases, the performance of the remediation or petroleum production process deteriorates markedly, requiring the extraction of larger and larger quantities of fluid to recover the desired amount of "product" (contaminant, oil, etc.). A simple model is presented for quantifying the effects of heterogeneity on vapor extraction, It was originally developed to determine the effect of heterogeneity on waterflooding for secondary oil recovery and subsequently extended to estimate the travel time distribution for radionuclides dissolved in water moving through fractured porous rock. Heterogeneity is quantified by a single parameter, σ, which determines the shape of a breakthrough curve for the transport of a tracer or other distinguishable fluid front as it moves through the medium. The resulting extraction model is simple enough to use in Monte Carlo and similar sampling procedures to estimate the uncertainty in cost or duration of the remediation project. 7 refs, 2 tabs, 14 figs.

0203 Drilling and Production

Refer also to citation(s) 2600, 2605, 2614, 3937

2603 (DOE/BC/14657–7) **Measuring and predicting reservoir heterogeneity in complex deposystems: Annual report, September 20, 1990–September 20, 1991.** Donaldson, A.; Shumaker, R.; Laughrey, C.; Aminian, K.; Hohn, M. Appalachian Oil and Natural Gas Research Consortium, Morgantown, WV (United States). Aug 1992. 171p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC22-90BC14657. Order Number DE92001068. Source: OSTI; NTIS; GPO Dep.

The Lower Mississippian Big Injun sandstone, a major oil producer in the western half of West Virginia, consists of several sandstones that overstep each west. Examination of cores and thin sections has led to preliminary interpretations of depositional environments for the Big Injun. These include distributary-mouth bars with associated distal, bar crest and back bar environments in a marine-deltaic system; and channel, point bar and chute environments in a fluvial system. Overall, the Big Injun is a medium-grained sublitharenite in which initially high porosity has been modified by compaction and diagenesis. Chlorite grain coatings helped to preserve original porosity, whereas illite promoted pressure solution during compaction, resulting in a loss of porosity. Diagenetic effects within specific environments are being evaluated to determine if environmental interpretations can be used to predict porosity preservation. Core plugs taken from cores in Granny Creek field were analyzed for porosity and horizontal and vertical permeability. Directional permeability was negligible, but permeability does correlate with depth. Changes in permeability with depth can be related to subdivisions of the Big Injun determined from density logs. Permeability also correlated with porosity, but porosity values derived from both cores and logs show no significant correlation trend at present. A layered reservoir model is being developed to evaluate the effect of these vertical heterogeneities. Initial attempts to characterize the heterogeneity of the Big Injun reservoir in Granny Creek field used a number of direct and indirect methods.

2604 (NIPER–633) **[National Institute for Petroleum and Energy Research] monthly progress report, July 1992.** National Inst. for Petroleum and Energy Research, Bartlesville, OK (United States). Sep 1992. 64p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FC22-83FE60149. Order Number DE93001396. Source: OSTI; NTIS; GPO Dep.

Accomplishments for the month of July are described briefly under tasks for: Energy Production Research; Fuels Research; and Supplemental Government Program. Energy Production Research includes: reservoir assessment and characterization; TORIS research support; development of improved microbial flooding methods; surfactant flooding methods; development of improved alkaline flooding methods; mobility control and sweep improvement in chemical flooding; gas flood performance prediction improvement; mobility control, profile modification, and sweep improvement in gas flooding; three-phase relative permeability research; thermal processes for light oil recovery; thermal processes for heavy oil recovery; and imaging techniques applied to the study of fluids in porous media. Fuel Research includes: development of analytical methodology for analysis of heavy crudes; and thermochemistry and thermophysical properties of organic nitrogen- and diheteroatom-containing compounds. Supplement Government Program includes: microbial-enhanced waterflooding field project; feasibility study of heavy oil recovery in the midcontinent region–Oklahoma, Kansas, and Missouri; surfactant-enhanced alkaline flooding field project; development of methods for mapping distribution of clays in petroleum reservoirs; summary of geological and

production characteristics of class 1. unstructured, deltaic reservoirs; third international reservoir characterization technical conference; process-engineering property measurements on heavy petroleum components; development and application of petroleum production technologies; upgrade BPO crude oil data base; simulation analysis of steam-foam projects; analysis of the US oil resource base and estimate of future recoverable oil; DOE education initiative project; and technology transfer to independent producers.

0204 Processing

Refer also to citation(s) 2534, 2535

0206 Health and Safety

2605 (DOE/MC/25027–3112) **Ice island creation, drift, recurrences, mechanical properties, and interactions with arctic offshore oil production structures: Final report.** Sackinger, W.M.; Jeffries, M.O.; Li, Fucheng; Lu, Mingchi. Alaska Univ., Fairbanks, AK (United States). Geophysical Inst. Mar 1991. 34p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG21-88MC25027. Order Number DE92012455. Source: OSTI; NTIS; GPO Dep.

Research and engineering studies on first-year sea ice for over two decades has resulted in the design, construction, and operation of jacket platforms, of artificial islands, and of massive gravity structures which routinely withstand moving sea ice of thickness up to 2 meters. However, the less-common interactions between such structures and moving multiyear ice ($\geq$3 meters thick), and also moving ice islands (10 to 60 meters thick) remain as the unknown and potentially most serious hazard for Arctic offshore structures. In this study, research was addressed across the complete span of remaining questions regarding such features. Ice island components, thickness distributions, scenarios and models for the interactions of massive ice features with offshore structures, all were considered. Ice island morphology and calving studies were directed at the cluster of 19 ice islands produced in a calving from the Ward Hunt Ice Shelf on Ellesmere Island in 1983, and also at a calving from the Milne Ice Shelf in 1988. The statistics of ice island dynamics, on both a short-term small-scale basis and also on a long-term basis, were studied. Typical wind velocities of 5 to 7.5 meters per second led to ice island speeds of about 0.014 of the wind speed, at an angle of 20° to the right of the wind direction. Ice island samples were tested for their stress/strain characteristics. Compressive strength values ranged from 1.64 MPa at a strain rate of 2×10^{-7} s^{-1} to 6.75 MPa at a strain rate of 1×10^{-3} s^{-1}. Scenarios for ice island/structure interactions were developed, and protective countermeasures such as spray ice and ice rubble barriers were suggested. Additional computer modeling of structure/ice interactions for massive ice features is recommended.

0207 Economic, Industrial, and Business Aspects

Refer also to citation(s) 2596, 2598, 3503

2606 (DOE/EIA–0109(92/10)) **Petroleum supply monthly, October 1992.** USDOE Energy Information Administration, Washington, DC (United States). Office of Oil and Gas. 27 Oct 1992. 172p. Sponsored by USDOE, Washington, DC (United States). Order Number DE93002637. Source: OSTI; NTIS; GPO; GPO Dep.

The Petroleum Supply Monthly (PSM) is one of a family of three publications produced by the Petroleum Supply Division within the Energy Information Administration (EIA) reflecting different levels of data timeliness and completeness. The other two publications are the Weekly Petroleum Status Report (WPSR) and the Petroleum Supply Annual (PSA). Data presented in the PSM describe the supply and disposition of petroleum products in the United States and major US geographic regions. The data series describe production, imports and exports, inter-Petroleum Administration for Defense (PAD) District movements, and inventories by the primary suppliers of petroleum products in the United States (50 States and the District of Columbia). The reporting universe includes those petroleum sectors in Primary Supply. Included are: petroleum refiners, motor gasoline blenders, operators of natural gas processing plants and fractionators, inter-PAD transporters, importers, and major inventory holders of petroleum products and crude oil. When aggregated, the data reported by these sectors approximately, represent the consumption of petroleum products in the United States. Data presented in the PSM are divided into two sections (1) the Summary Statistics and (2) the Detailed Statistics.

2607 (DOE/EIA–0380(92/10)) **Petroleum marketing monthly, October 1992.** USDOE Energy Information Administration, Washington, DC (United States). Office of Oil and Gas. 14 Oct 1992. 191p. Sponsored by USDOE, Washington, DC (United States). Order Number DE93002635. Source: OSTI; NTIS; GPO; GPO Dep.

The Petroleum Marketing Monthly is prepared by the Petroleum Marketing Division, Office of Oil and Gas, Energy Information Administration. The Petroleum Marketing Monthly (PMM) is designed to give information and statistical data about a variety of crude oils and refined petroleum products. The publication provides statistics on crude oil costs and refined petroleum products sales for use by industry, government, private sector analysts, education institutions, and consumers. Data on crude oil include the domestic first purchase price, the f.o.b. and landed cost of imported crude oil, and the refiners' acquisition cost of crude oil. Sales data for motor gasoline, distillates, residuals, aviation fuels, kerosene and propane are presented.

2608 (DOE/EIA–0380(92/11)) **Petroleum marketing monthly, November 1992.** USDOE Energy Information Administration, Washington, DC (United States). Office of Oil and Gas. 9 Nov 1992. 179p. Sponsored by USDOE, Washington, DC (United States). Order Number DE93003221. Source: OSTI; NTIS; GPO; GPO Dep.

The Petroleum Marketing Monthly (PMM) is designed to give information and statistical data about a variety of crude oils and refined petroleum products. The publication provides statistics on crude oil costs and refined petroleum products sales for use by industry, government, private sector analysts, educational institutions, and consumers. Data on crude oil include the domestic first purchase price, the f.o.b. and landed cost of imported crude oil, and the refiners' acquisition cost of crude oil. Sales data for motor gasoline, distillates, residuals, aviation fuels, kerosene, and propane are presented.

2609 (DOE/EIA–0538(92/93-1)) **Winter fuels report week ending, October 9, 1992.** USDOE Energy Information Administration, Washington, DC (United States). Office of Oil and Gas. 14 Oct 1992. 81p. Sponsored by USDOE, Washington, DC (United States). Order Number DE93001567. Source: OSTI; NTIS; GPO Dep.

The Winter Fuels Report is intended to provide concise, timely information to the industry, the press, policymakers, consumers, analysts, and State and local governments on the following topics: distillate fuel oil net production, imports and stocks on a US level and for all Petroleum Administration for Defense Districts (PADD) and product supplied on a US level; propane net production, imports and stocks on a US level and for PADD's I, II, and III; natural gas supply and disposition and underground storage for the US and consumption for all PADD'S; as well as selected National average prices; residential and wholesale pricing data for heating oil and propane for those States participating in the joint Energy Information Administration (EIA)/State Heating Oil and Propane Program; crude oil and petroleum price comparisons for the US and selected cities; and a 6–10 Day, 30-Day, and 90-Day outlook for temperature and precipitation and US total heating degree-days by city.

2610 (DOE/EIA–0538(92/93-2)) **Winter fuels report, week ending October 15, 1992.** USDOE Energy Information Administration, Washington, DC (United States). Office of Oil and Gas. 22 Oct 1992. 72p. Sponsored by USDOE, Washington, DC (United States). Order Number DE93001889. Source: OSTI; NTIS; GPO Dep.

The Winter Fuels Report is intended to provide concise, timely information to the industry, the press, policymakers, consumers, analysts, and State and local governments on the following topics: distillate fuel oil net production, imports and stocks on a US level and for all Petroleum Administration for Defense Districts (PADD) and product supplied on a US level; propane net production, imports and stocks on a US level and for PADD's I, II, and III; natural

gas supply and disposition and underground storage for the US and consumption for all PADD'S; as well as selected National average prices; residential and wholesale pricing data for heating oil and propane for those States participating in the joint Energy Information Administration (EIA)/State Heating Oil and Propane Program; crude oil and petroleum price comparisons for the US and selected cities; and a 6–10 Day, 30-Day, and 90-Day outlook for temperature and precipitation and US total heating degree-days by city.

2611 (DOE/EIA–0538(92/93-3)) **Winter fuels report week ending, October 23, 1992.** USDOE Energy Information Administration, Washington, DC (United States). Office of Oil and Gas. 29 Oct 1992. 72p. Sponsored by USDOE, Washington, DC (United States). Order Number DE93001325. Source: OSTI; NTIS; GPO Dep.

The Winter Fuels Report is intended to provide concise, timely information to the industry, the press, policymakers, consumers, analysts, and State and local governments on the following topics: distillate fuel oil net production, imports and stocks on a US level and for all Petroleum Administration for Defense Districts (PADD) and product supplied on a US level; propane net production, imports and stocks on a US level and for PADD's I, II, and III; natural gas supply and disposition and underground storage for the US and consumption for all PADD'S; as well as selected National average prices; residential and wholesale pricing data for heating oil and propane for those States participating in the joint Energy Information Administration (EIA)/State Heating Oil and Propane Program; crude oil and petroleum price comparisons for the US and selected cities; and a 6–10 Day, 30-Day, and 90-Day outlook for temperature and precipitation and US total heating degree-days by city.

2612 (DOE/EIA–0538(92/93-4)) **Winter fuels report, week ending October 30, 1992.** USDOE Energy Information Administration, Washington, DC (United States). Office of Oil and Gas. 5 Nov 1992. 82p. Sponsored by USDOE, Washington, DC (United States). Order Number DE93002751. Source: OSTI; NTIS; GPO Dep.

The Winter Fuels Report is intended to provide concise, timely information to the industry, the press, policymakers, consumers, analysts, and State and local governments on the following topics: distillate fuel oil net production, imports and stocks on a US level and for all Petroleum Administration for Defense Districts (PADD) and product supplied on a US level; propane net production, imports and stocks on a US level and for PADD's I, II, and III; natural gas supply and disposition and underground stage for the US and consumption for all PADD's; as well as selected National average prices. Residential and Wholesale pricing data for heating oil and propane for those States participating in the joint Energy Information Administration (EIA)/State Heating Oil and Propane Program; crude oil and petroleum price comparisons for the US and selected cities; and a 6–10 Day, 30-Day, and 90-Day outlook for temperature and precipitation and US total heating degree-days by city.

2613 (DOE/EIA–M028(92)) **Oil Market Simulation model user's manual.** USDOE Energy Information Administration, Washington, DC (United States). Office of Integrated Analysis and Forecasting. Jul 1992. 12p. Sponsored by USDOE, Washington, DC (United States). Order Number DE93002213. Source: OSTI; NTIS; GPO; INIS; GPO Dep.

The Oil Market Simulation (OMS) model is a LOTUS 1-2-3 spreadsheet that simulates the world oil market. OMS is an annual model that projects the world oil market through the year 2010 from a data base that begins in 1979. The geographic coverage includes all market economies, with net imports from the centrally planned economies taken as an assumption. The model estimates the effects of price changes on oil supply and demand and computes an oil price path over nine that allows supply and demand to remain in balance within the market economies area as a whole. The input assumptions of OMS are highlighted (in color) on the spreadsheet and include the following: The capacity of the OPEC countries to produce petroleum liquids (crude oil, natural gas liquids, condensates, refinery gains); a reference case projection of regional oil supply and demand at some arbitrary reference path of oil prices over time. The reference case provided with this diskette is that used for EIA's latest base case in the International Energy Outlook 1992 DOE/EIA-0484(92). The demonstration requires an IBM PC (or compatible), preferably with a color monitor. The demonstration diskette is self-contained, with all the files needed to run the demonstration. It does not, however, have the DOS system files, so this diskette cannot be used to start (boot) the computer.

0208 Waste Management

Refer also to citation(s) 2976

2614 (SR/RNGD–92-01) **Water treatment technology costs associated with offshore oil and gas production.** USDOE Energy Information Administration, Washington, DC (United States). Office of Oil and Gas. Jul 1992. 28p. Sponsored by USDOE, Washington, DC (United States). Order Number DE93002217. Source: OSTI; NTIS; GPO; GPO Dep.

The Environmental Protection Agency (EPA) is collecting cost data related to its proposed waste water cleanliness regulations. The Energy Information Administration's (EIA) Dallas Field Office (DFO) agreed to help gather the data. The proposed EPA regulations will limit the oil and grease content of discharged water produced from oil and gas reservoirs. The current oil and grease content limit is 48 parts per million (p/m) and the proposed limit is 15 p/m. These regulations affect oil and gas well operators working in Federally-controlled waters off the coastlines of the United States. These coastlines include those of Alaska and California, but the bulk of the data comes from the Gulf of Mexico area. The focus of this report is on processes now available which are useful in reducing the volume of oil and grease in treated waste water. This water comes from oil and gas reservoirs, passing from wells into a surface process facility. The processes investigated include multimedia filtration, hydrocyclones, reinjection of produced water, pumping waste water to shore via pipelines and, as an adjunct, erection of platforms for the sole purpose of water treatment. This report presents the estimated cost of compliance with proposed EPA regulations by use of currently existing auxiliary processes. The desired reduction of oil residue in produced water may result from the addition of a single process or several processes. The order of the processes described in this report is significant. The most common type of treatment is the multimedia filter. The hydrocyclone, still proving itself to many operators, is gaining rapidly in popularity. The remaining options, which include reinjection of the water, pumping the water to shore installations, or erecting entirely new platforms for water treatment, are costlier and thus are less likely solutions.

0209 Environmental Aspects

2615 (CONF-9109358–, pp. 21) **The Mazovarian Refinery and Petrochemical Works emission influence onto chemical content of cultivated plants.** Zimny, Henryk (Warsaw Agricultural Univ. (Poland)); Mikula, Waldemar. USDOE, Washington, DC (United States). [1991]. From 8. international conference on chemistry for protection of the environment; Lublin (Poland); 16-18 Sep 1991. In *Chemistry for protection of the environment, Eight international conference: Proceedings.* 635p. Order Number DE92014317. Source: OSTI; NTIS; INIS.

Plock and its surroundings (Central Poland) in 1982 was counted as a area of ecological threat (Gorka, Poskrobko 1987). There have been distinguished 27 such terrains, embracing total amount of 11.3 per cent of Poland's area. In the Plock region the main source of environmental pollution are Mazovian Refinery and Petrochemical Works (MRPW) emissions in Plock, the second greatest plant of this type in Europe. This enterprise emits very wide scale of pollutions (about 30 groups of chemical compounds), mainly gaseous. For example in 1988 MRPW have been sending into atmosphere up to 113,936 tons of gaseous pollutions, the most of all chemical plants in Poland (GUS 1989). Inquiries concerning influence of Plock Petrochemical Works onto environment had started already in 1970. They have comprised horticultural, agricultural, forest and grassy ecosystems. The main goal of this research was to appoint threaten area and dynamics of changes in phytocenoses. Important position have embraced wide chemical analysis of cultured plants. The target was to show differences in chemical state depending on the distance from the factory, the organ and species of plant, to define plants accumulation from

Works, to define plants accumulation ability for particular harmful pollutions and ascertain the state of crops and consumers threat.

2616 (CONF-9109358–, pp. 9) **Comparison of Hanby field test kit procedures for petroleum contaminated water and soil with field and laboratory methods of analysis.** Hanby, J.D. USDOE, Washington, DC (United States). [1991]. From 8. international conference on chemistry for protection of the environment; Lublin (Poland); 16-18 Sep 1991. In *Chemistry for protection of the environment, Eight international conference: Proceedings.* 635p. Order Number DE92014317. Source: OSTI; NTIS; INIS.

Since the introduction of the Hanby method for the analysis of petroleum hydrocarbons in the fall of 1987 this extraction-colorimetric technique has been found to be of great utility in a wide range of environmental applications. The need for a simple, rapid method for highly accurate quantitative analysis of petroleum contaminated soils had become apparent with the mounting concern about leakage from underground fuel and solvent storage tanks. It was the discovery, in early 1980, of significant soil and groundwater contamination from solvent storage tanks and thermochemical test sites at NASA's LBJ space center in Houston, Texas, that prompted the author's search for such a field method. Well-established methods of analysis of organic contamination were available in the laboratory. Certainly the close proximity of the environmental laboratory at LBJ allowed for rapid analysis of drilling core samples taken as the 'plumes' of contamination were investigated and sampling wells were established. Despite such facilitatory arrangements, however, it was found that supposedly replicate core samples displayed a disconcertingly wide range of analytical protocols in efforts to reduce the disparities with little effect. Subsequently, a 'best effort' approach to the task was adopted as necessary to the resolution of the immediate, and fairly expensive, concerns of monitor well emplacement.

2617 (CONF-9109358–, pp. 6) **Real-time in-situ monitoring of hydrocarbon leakage: A fiber optic chemical sensor (FOCS) comes to the rescue.** Klainer, S.M. (FiberChem, Inc., Las Vegas, NV (United States)); Thomas, J.R.; Dandge, D.K.; Frank, C.A.; Butler, M.A.; Arman, H.; Goswami, K.; Eccles, L.; Durgin, P.; D'Lugosz, J. USDOE, Washington, DC (United States). [1991]. From 8. international conference on chemistry for protection of the environment; Lublin (Poland); 16-18 Sep 1991. In *Chemistry for protection of the environment, Eight international conference: Proceedings.* 635p. Order Number DE92014317. Source: OSTI; NTIS; INIS.

Hydrocarbon spills, either from a leaky underground storage tank or from a damaged tanker, pose a severe threat to public health and to the ecosystem. To monitor the contamination of water by hydrocarbons, and their intrusion into the vadose zone, a fiber optic chemical sensor (FOCS) has been developed. The complete system has three basic parts: (a) the sensor, (b) a photometer, and (c) a computerized data acquisition and transmission module. The sensor consists of a piece of fiber optic with hydrocarbon specific coating applied on the bare core. Depending on the concentration of hydrocarbon (HC) in the immediate vicinity of the FOCS, the intensity of light passing from one end of the fiber to the other is modulates. The photometer transforms the resultant optical signal into a voltage which is fed to a computer for processing.

2618 (DOE/EIS–0165-D-Vol.2) **Expansion of the Strategic Petroleum Reserve, Alabama, Louisiana, Mississippi, and Texas: Draft environmental impact statement: Volume 2, Chapters 6–13.** USDOE, Washington, DC (United States). Oct 1992. 330p. Sponsored by USDOE, Washington, DC (United States). Order Number DE93002187. Source: OSTI; NTIS; INIS; GPO Dep.

The proposed action entails the development of a plan for 250 million barrels of new crude oil storage capacity in two Gulf Coast salt domes to expand the Strategic Petroleum Reserve pursuant to Congressional directive (PL 101–383 and PL 101–512). Storage capacity would be developed by solution-mining the salt which would require about two billion barrels of surface water and would generate about two billion barrels of salt brine. The brine would be disposed of primarily by ocean discharge and alternatively by deep underground injection. Crude oil fill and distribution systems would require new pipelines and terminal facilities. This EIS assesses the impacts of construction and operation for the range of alternatives being considered and focuses on oil and brine spill risk and impacts of brine disposal, water and land use, groundwater contamination, hydrocarbon emissions, and involvement with wetlands and floodplains. This volume focuses on the environmental risks and public occupational health and safety, environmental impacts, regulatory requirements and mitigation methods, the relationship between local short-term use and long-term productivity, and the commitment of resources.

2619 (DOE/EIS–0165-D-Vol.3) **Expansion of the Strategic Petroleum Reserve, Alabama, Louisiana, Mississippi, and Texas: Draft Environmental Impact Statement: Volume 3, Technical appendices.** USDOE, Washington, DC (United States). Oct 1992. 427p. Sponsored by USDOE, Washington, DC (United States). Order Number DE93002188. Source: OSTI; NTIS; INIS; GPO Dep.

The proposed action entails the development of a plan for 250 million barrels of new crude oil storage capacity in two Gulf Coast salt domes to expand the Strategic Petroleum Reserve pursuant to Congressional directive (PL 101–383 and PL 101–512). Storage capacity would be developed by solution-mining the salt which would require about two billion barrels of surface water and would generate about two billion barrels of salt brine. The brine would be disposed of primarily by ocean discharge and alternatively by deep underground injection. Crude oil fill and distribution systems would require new pipelines and terminal facilities. This EIS assesses the impacts of construction and operation for the range of alternatives being considered and focuses on oil and brine spill risk and impacts of brine disposal, water and land use, groundwater contamination, hydrocarbon emissions, and involvement with wetlands and floodplains. This volume contains 20 appendices.

2620 (EGG–10617-2147) **Five-year resurvey for endangered species on Naval Petroleum Reserve No. 1, (Elk Hills), Kern County, California.** Otten, M.R.M.; O'Farrell, T.P.; Briden, L.E. EG and G Energy Measurements, Inc., Goleta, CA (United States). Santa Barbara Operations. Jun 1992. 124p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC08-88NV10617. Order Number DE93001566. Source: OSTI; NTIS; INIS; GPO Dep.

A transect survey of Naval Petroleum Reserve No. 1 (NPR-1), Kern County, California, was conducted between July 3 and August 5, 1989 to determine the distribution and relative density of endangered species and other wildlife. Results were compared with other reported results, particularly the 1979 and 1984 surveys of NPR-1. A total of 589.8 miles of transects were walked through approximately 47,235 acres in all or parts of 81 sections. Of the 516 San Joaquin kit fox dens observed, 496 were typical subterranean dens and 20 were atypical dens in man-made structures. Estimated den density was 36.7 $\pm$ 4.1 per square mile; and relative den density was 10.5/1,000 acres for all of NPR-1. Characteristics of typical kit fox dens were comparable to characteristics reported for other studies, except mean number of entrances per den, which was lower. Observers counted a total of 300 dens previously marked with an identification sign, 191 of which contained at least one complete entrance and would have been observed without a sign. Relative densities of preferred kit fox prey, black-toiled jackrabbits (40.1/1,000 acres) and desert cottontails (14.1/1,000 acres), were lower than previously recorded. Five blunt-nosed leopard lizards were observed along the southwest and northeast perimeter of the Reserve. Most of the 59 giant kangaroo rat burrow systems were observed in the flat terrain along the northeast and south perimeters of the Reserve. San Joaquin antelope squirrels were observed in the central and western parts of NPR- 1. A total of 73 antelope squirrels were observed, and the relative density was 1.511,000 acres. A total.of 30 possible environmental hazards were observed during transect surveys. Most of these were oil and water leaks of small size and appeared to pose little risk to endangered species. Results of this survey indicate that NPR-1 is supporting less wildlife than it did during either the 1979 or 1984 surveys.

0220 Transport, Handling, and Storage

Refer also to citation(s) 2594, 2617

2621 (DOE/FE–0268P) **Strategic Petroleum Reserve quarterly report.** USDOE Assistant Secretary for Fossil Energy, Washington, DC (United States). Office of Strategic Petroleum Reserve. 15 Aug 1992. 8p. Sponsored by USDOE, Washington, DC (United States). Order Number DE93002235. Source: OSTI; NTIS; GPO Dep.

The Strategic Petroleum Reserve (SPR) was created pursuant to the Energy Policy and Conservation Act (EPCA) Public Law 94-163, approved on December 22, 1975, and extended in July 1985, June 1989, March 1990, and September 1990, to reduce the impact of disroptions in petroleum supplies and to carry out obligations of the United States under the Agreement on an International Energy Program. The Strategic Petroleum Reserve Quarterly Report is submitted in accordance with section 165(b) of the Energy Policy and Conservation Act, as amended, which requires that the Secretary of Energy submit quarterly reports to Congress on activities undertaken with respect to the Strategic Petroleum Reserve. Since the Strategic Petroleum Reserve crude oil storage facilities program for the 750 minion barrels was completed in 1991, this August 15, 1992, Strategic Petroleum Reserve Quarterly Report focuses on activities related primarily to the storage facilities status, oil acquisition, budget, and cost of the Reserve during the period April 1, 1992, through June 30, 1992.

2622 (SAND–92-2042C) **Effects of anomalous salt features on caverns in Gulf Coast domes.** Sandia National Labs., Albuquerque, NM (United States). [1992]. 4p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-76DP00789. (CONF-9210180–1: Solution Mining Research Institute (SMRI) fall meeting, Houston, TX (United States), 19-21 Oct 1992). Order Number DE93000747. Source: OSTI; NTIS; GPO Dep.

Early solution miners encountered occasional difficulties with nonsymmetric caverns (including "wings" and "chimneys"), gas releases, insoluble stringers, and excessive anhydrite "sands." Apparently there was no early recognition of trends for these encounters, although certain areas were avoided after problems appeared consistently within them. Solution mining has now matured, and an accumulation of experience indicates that anomalous salt features occur on a number of Gulf Coast domes. Trends incorporating concentrations of anomalous features will be referred to as "anomalous zones," or AZs (after Kupfer). The main objective of this Project is to determine the effects of AZ encounters on solution-mined caverns and related storage operations in domes. Geological features of salt domes related directly to cavern operations and AZs will be described briefly, but discussions of topics related generally to the evolution of Gulf Coast salt structures are beyond the scope of this Project.

0230 Properties and Composition

Refer also to citation(s) 2604, 4788

0250 Combustion

Refer also to citation(s) 2600

03 NATURAL GAS

0302 Reserves, Geology, and Exploration

Refer also to citation(s) 2598, 2601, 2624

0303 Drilling, Production, and Processing

Refer also to citation(s) 2626

2623 (DOE/CE/40938–2) **Collection of VLE data for acid gas—alkanolamine systems using fourier transform infrared spectroscopy: Phase 2, October 1, 1991–September 30, 1992.** Bullin, J.A.; Frazier, R.E. Texas A and M Univ., College Station, TX (United States). Texas Engineering Experiment Station. [1992]. 25p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FC02-90CE40938. Order Number DE93003653. Source: OSTI; NTIS; GPO Dep.

The industrial standard process for the purification of natural gas is to remove acid gases, mainly hydrogen sulfide and carbon dioxide, by the absorption and reaction of these gases with alkanolamines. Inadequate data for vapor–liquid equilibrium (VLE) hinder the industry from converting operations to more energy efficient amine mixtures and conserving energy. Some energy reductions have been realized in the past decade by applying such amine systems as "hindered" amines, methyldiethanolamine (MDEA), and MDEA based amine mixtures. However, the lack of reliable and accurate fundamental VLE data impedes the commercial application of these more efficient alkanolamine systems. The first project objective is to improve the accuracy of vapor–liquid equilibrium measurements at low hydrogen sulfide concentrations. The second project objective is to measure the VLE for amine mixtures. By improving the accuracy of the VLE measurements on MDEA and mixtures with other amines, energy saving can be quickly and confidently implemented in the many existing absorption units already in use. If about 25% of the existing 95.3 billion SCFD gas purification capacity is converted to these new amine systems, the energy savings are estimated to be about 3×10^{14} BTU/yr.

2624 (DOE/MC/25115–3113) **Selection of area and specific site for drilling a horizontal well in Calhoun County, West Virginia.** Reeves, T.K.; Overbey, W.K. Jr.; Salamy, S.P.; Locke, C.D. BDM Engineering Services Co., McLean, VA (United States). Mar 1992. 145p. Sponsored by USDOE, Washington, DC (United States). Order Number DE92012456. Source: OSTI; NTIS; GPO Dep.

This report discusses the data collection and analysis procedures used to establish criteria for geologic and engineering studies conducted by BDM to select a general area for more detailed study and a specific site for the drilling of a cooperative well with an industry partner, the Consolidated Natural Gas Development Company (CNGD). The results of detailed geologic studies are presented for two areas in Calhoun County, West Virginia, and one area along the Logan-Boone County line in West Virginia. The effects of Appalachian Basin tectonics and the Rome Trough Rift system were identified on seismic lines made available by (CNGD). These helped to identify and define the trapping mechanisms which had been effective in each area. Engineering analyses of past production histories provided data to support selection of target areas and then to select a specific site that met the project requirements for production, reservoir pressure, and risk. A final site was selected in Lee District at the southwestern margin of the Sand Ridge gas field based on the combination of a geologic trapping mechanism and reservoir pressures which were projected as 580 psi with a stress ratio of 0.53.

0306 Economic, Industrial, and Business Aspects

Refer also to citation(s) 2596, 2598, 2609, 2610, 2611, 2612

2625 (DOE/EIA–0130(92/10)) **Natural gas monthly, October 1992.** USDOE Energy Information Administration, Washington, DC (United States). Office of Oil and Gas. 10 Nov 1992. 135p. Sponsored by USDOE, Washington, DC (United States). Order Number DE93003222. Source: OSTI; NTIS; GPO; GPO Dep.

The NGM highlights activities, events, and analyses of interest to public and private sector organizations associated with the natural gas industry. Volume and price data are presented each month for natural gas production, distribution, consumption, and interstate pipeline activities. Producer-related activities and underground storage data are also reported. From time to time, the NGM features articles designed to assist readers in using and interpreting natural gas information.

0307 Waste Management

2626 (DOE/CE/15488–T7) **System for recovering sulfur from gases, especially natural gas: Final report, February 1991–July 1992.** Gryka, G.E. PIPco, Inc., Southport, CT (United States). Sep 1992. 13p. Sponsored by USDOE, Washington, DC

(United States). DOE Contract FG01-90CE15488. Order Number DE92040995. Source: OSTI; NTIS; GPO Dep.

The objective of this project is to design, construct and operate a laboratory reactor to convert hydrogen sulfide into liquid sulfur, using a patented PIPco process as a basis. Reaction conditions will be studied, continuous regenerative operation demonstrated, and data necessary to design a field test system will be collected. The subject process is a regenerative buffered water circulating system with two primary steps: (1) loading of the solution with SO_2 (which can be generated by burning sulfur or H_2S), and (2) H_2S separation - reaction to form sulfur - and sulfur separation. Many regenerative liquid redox sulfur recovery systems offer potential for combining H_2S separation and sulfur formation into one step. PIPco's data and engineering study suggest the process may have advantages over other liquid systems: Use of potassiurti citrate buffer increases sulfur dioxide (oxidizing agent) loading by a factor of 8 or more, up to 160 grams SO_2/liter of solution can be carried to the separator - reactor, thereby reducing liquid circulating rates and equipment size. The separator - reactor is operated at a temperature above 120°C (the melting point of elemental sulfur). Therefore, sulfur is produced and separated in liquid form. This eliminates sulfur plugging and separation problems by avoiding the production of solid sulfur.

0320 Transport, Handling, and Storage

2627 (GRI–91/0280) **Use of geographic information systems for applications on gas pipeline rights-of-way: Final report, December 1989–December 1991.** Thompson, P.J. (Argonne National Lab., IL (United States)). Gas Research Inst., Chicago, IL (United States). Environment and Safety Research Dept.; Argonne National Lab., IL (United States). Dec 1991. 54p. Sponsored by Gas Research Inst., Chicago, IL (United States). DOE Contract W-31109-ENG-38. Order Number DE93002267. Source: OSTI; NTIS; GPO Dep.

Geographic information system (GIS) applications for the siting and monitoring of gas pipeline rights-of-way for this project (ROWs) were developed for areas near Rio Vista, California. The data layers developed for this project represent geographic features, such as landcover, elevation, aspect, slope, soils, hydrography, transportation, endangered species, wetlands, and public line surveys. A GIS was used to develop and store spatial data from several sources; to manipulate spatial data to evaluate environmental and engineering issues associated with the siting, permitting, construction, maintenance, and monitoring of gas pipeline ROWS; and to graphically display analysis results. Examples of these applications include (1) determination of environmentally sensitive areas, such as endangered species habitat, wetlands, and areas of highly erosive soils; (2) evaluation of engineering constraints, including shallow depth to bedrock, major hydrographic features, and shallow water table; (3) classification of satellite imagery for landuse/landcover that will affect ROWs; and (4) identification of alternative ROW corridors that avoid environmentally sensitive areas or areas with severe engineering constraints.

0340 Combustion

Refer also to citation(s) 3558

04 OIL SHALES AND TAR SANDS

0402 Reserves, Geology, and Exploration

Refer also to citation(s) 2601

0404 Oil Production, Recovery, and Refining

2628 (DOE/CE/15533–T3) **High efficiency shale oil recovery: Third quarterly report, July 1, 1992–September 30, 1992.** Adams, D.C. Energy Recovery Technology, Salt Lake City, UT (United States). [1992]. 8p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG01-92CE15533. Order Number DE93001956. Source: OSTI; NTIS; GPO Dep.

The overall project objective is to demonstrate the high efficiency of the Adams Counter-Current shale oil recovery process. The efficiency is first being demonstrated at bench scale, in the current phase, after which the demonstration will be extended to the operation of a small pilot plant. Thus the immediate project objective is to obtain data on oil shale retorting operations in a small batch rotary kiln that will be representative of operations in the proposed continuous process pilot plant. This batch kiln is a unit constructed in a 1987 Phase I SBIR tar sand retorting project. The kiln worked fairly well in that project; however, the need for certain modifications was observed. These modifications, now completed, provide for a great improvement in the operation and make the data and analysis more exact. Last quarter we reported on equipment modifications and refurbishments which resulted in a sophisticated analytical rotary kiln. As we began operating the equipment this quarter, we observed that the software package was inadequate for our purpose and that the appropriate software could not be purchased as a shelf item. Therefore, we were required to modify the equipment interface and to write our own software. The quartz sand kiln calibration runs have been completed and the results are included in this report. Computer Interface: The computer interface was designed on CTR-05, DAS-08 and MUX-32 Boards from ComputerBoards Inc. We purchased a software program, Control EG by Quinn-Curtis, to use with these boards. As we began operating the equipment we realized that the software control was inadequately sensitive for our system as it would not provide time-proportioning output. This problem was resolved by writing our own software and providing time-proportioning duty cycles for the output to each of five heaters. We have entitled this program "Kilntrol." It is included in the Appendix of this report.

05 NUCLEAR FUELS

Refer also to citation(s) 3566, 3766

2629 (KAERI/AR–337/91) **A state-of-the-art report on the in-reactor densification and resintering test.** Song, Keun Woo (Korea Atomic Energy Research Inst., Daeduk (Korea, Republic of)). Korea Atomic Energy Research Inst., Daeduk (Korea, Republic of). Dec 1991. 48p. (In Korean). Order Number DE93606677. Source: OSTI; NTIS (US Sales Only); INIS.

A state-of-the-art has been reviewed on the in-reactor densification and the resintering test in order to utilize for designing the stable pellet which shows a little volume changes during irradiation. The in-reactor densification occurs due to shrinkage and annihilation of pores, it is influenced by the pore size among microstructural features rather than the grain size or the initial density. Pores less than 1 μm are very stable and in some cases show growth. Therefore, the in-reactor densification behavior mainly depends on the pore reviewed. It is necessary that the assumptions of MacEwen and Hasting's model are complemented adequately from a viewpoint of material. Dollins and Nichols' model requires much comparisons with experimental data. Assmann and Stehle's model predicts accurately the effects of the grain size and the pore size on the in-reactor densification. The resintering test is widely used in estimating the in-reactor densification indirectly. The condition of resintering test is determined to meet the same densification that the pellet with the well-known pore structure shows during irradiation. Thus it is thought that the current resintering test can be applied not to the developing pellet which may have different pore structures, but to the developed pellet. A review of a state-of-the-art on the in-reactor densification leads to the conclusion that the stable pellet can be designed by determining the pore structure which shows a required in-reactor densification. Also in the stage of developing pellets, the new approach to the resintering test is probably beneficial which considers material characteristics of the pellet during irradiation. (Author).

0501 Reserves, Exploration, and Mining

Refer also to citation(s) 2719, 2720, 2721, 2722, 2818, 3036, 3038

2630 (IAEA-TECDOC–650, pp. 13-22) **Uranium in granitoids: Recognition criteria of uranium provinces in Brazil.** Tassinari, C.C.G. (Sao Paulo Univ., SP (Brazil). Inst. de Geociencias); Barretto, P.M.C. International Atomic Energy Agency, Vienna (Austria); Nuclear Energy Agency, 75 - Paris (France). Jun 1992. (CONF-9108224–: Technical committee meeting on new developments in uranium exploration, resources, production and demand, Vienna (Austria), 26-29 Aug 1991). In *New developments in uranium exploration, resources, production and demand: Proceedings of a technical committee meeting held in Vienna, 26-29 August 1991.* 258p. Order Number DE93607128. Source: OSTI; NTIS (US Sales Only); INIS.

Uranium distribution in granitoids, including gneisses and migmatites were investigated for the rocks of entire Brazilian territory. Uranium concentrations were determined in 1800 Rb-Sr whole rock isotopic analysed samples with known geological setting. The samples were plotted in Brazil's geotectonic outline, and those with high U contents (above 12 ppm) provide the characterization of probable uraniferous provinces. In addition the results were interpreted in relation to age, tectonic environment, lithologies, Rb contents and $^{97}Sr/^{94}Sr$ initial ratios. With respect to the lithology, the granites with alkaline compositions showed higher U contents than their host rocks which consist of gneissic-migmatic terranes, and other granitoids. In general the Uranium-enriched rocks are mainly related to the Mid-Proterozoic time. In terms of isotopic geochemistry, the higher $^{97}Sr/^{94}Sr$ ratio rocks (high Rb contents) showed a uranium enrichment trend when compared with those less differentiated material. On the other hand, rocks with low Sr initial ratio may present Uranium concentrations similar to those with high initial ratios, which suggest the primary Uranium enrichment process during the mantle-derived rock-forming process. (author). 30 refs, 9 figs.

2631 (IAEA-TECDOC–650, pp. 22-29) **Baseline uranium exploration surveys and their use in the early detection of potential natural hazards: A case history from Sudan.** Parslow, G.R. (Regina Univ., Regina, SK (Canada). Dept. of Geology); Khalil, B.; Hassan, A.R.K. International Atomic Energy Agency, Vienna (Austria); Nuclear Energy Agency, 75 - Paris (France). Jun 1992. (CONF-9108224–: Technical committee meeting on new developments in uranium exploration, resources, production and demand, Vienna (Austria), 26-29 Aug 1991). In *New developments in uranium exploration, resources, production and demand: Proceedings of a technical committee meeting held in Vienna, 26-29 August 1991.* 258p. Order Number DE93607128. Source: OSTI; NTIS (US Sales Only); INIS.

In 1969, a small dam was erected on Khor Berdab about 20 Km NW of Kadugli, Southern Kordofan Province, Sudan. In 1982, one of the authors reported on field work that established that Lake Miri straddled a zone of pitchblende mineralization (vein-type) and constituted a potential health hazard. In 1985, a further visit revealed radon values of about 3000 cpm in springs behind the dam and in UNICEF well water at the village of Hayat el Nar, near Kadugli. It was also noted that the well water contained 380 ppb U. In 1986, as part of IAEA TC project SUD/3/003-1, the authors revisited the area and ran two profiles with a GAD-6, four channel, gamma ray spectrometer (one south and one north of the lake) to better define the extent and magnitude of the radioactive zone. In 1988, a final visit was undertaken to assess radon values in some village wells and in soils around wells and near the lake. Virtually all ten locations visited returned anomalous values; the highest Rn value for water exceeded 8000 cpm. This case history illustrates that the dissemination and integration of "early" uranium exploration survey data into the projects of other agencies (e.g. WHO, UNICEF, NGO, and Gov't) is imperative and would help to avoid scenarios such as the present unfortunate situation around Lake Miri. 1 ref., 4 figs, 3 tabs.

2632 (IAEA-TECDOC–650, pp. 29-33) **Study of airborne gamma ray spectrometric data in prediction of uraniferous mineralizations in the Kuusamo area, northeastern Finland.** Arkimaa, H. (Geologinen Tutkimuslaitos, Espoo (Finland)). International Atomic Energy Agency, Vienna (Austria); Nuclear Energy Agency, 75 - Paris (France). Jun 1992. (CONF-9108224–: Technical committee meeting on new developments in uranium exploration, resources, production and demand, Vienna (Austria), 26-29 Aug 1991). In *New developments in uranium exploration, resources, production and demand: Proceedings of a technical committee meeting held in Vienna, 26-29 August 1991.* 258p. Order Number DE93607128. Source: OSTI; NTIS (US Sales Only); INIS.

The Early Proterozoic Kuusamo Schist Belt in northeastern Finland contains many uraniferous mineralizations. Both bare U-mineralizations and Au-Co-U-bearing sulphide mineralizations have been found. At the moment exploration is carried out mainly for gold. Low altitude airborne magnetic, electromagnetic and gamma-ray measurements have been flown at an altitude of 30-50m with a 200m line spacing. Many of the gold bearing formations, so far discovered, are clearly indicated by the airborne magnetic and electromagnetic data. Some are indicated by gamma-ray data. Since only three percent of the bedrock in Finland is exposed, factors such as thickness of overburden and moisture content must be considered when interpreting gamma measurements. The ratios between the different energy channels proved to be the best variables to characterize the largest known uraniferous mineralizations under various overburden layers. Digital image processing and statistical operations were used to study how the known U- and Au-Co-U-bearing sulphide mineralizations are indicated in low altitude airborne gamma-ray data and how these measurements could be used more effectively in ore prospecting in the area. (author). 9 refs, 8 figs.

2633 (IAEA-TECDOC–650, pp. 33-34) **Some aspects of the uranium situation in Romania.** Bejenaru, C. (Regia Autonoma Pentru Metale Rare, Bucharest (Romania)); Bobe, M. International Atomic Energy Agency, Vienna (Austria); Nuclear Energy Agency, 75 - Paris (France). Jun 1992. (CONF-9108224–: Technical committee meeting on new developments in uranium exploration, resources, production and demand, Vienna (Austria), 26-29 Aug 1991). In *New developments in uranium exploration, resources, production and demand: Proceedings of a technical committee meeting held in Vienna, 26-29 August 1991.* 258p. Order Number DE93607128. Source: OSTI; NTIS (US Sales Only); INIS.

Uranium exploration in Romania started in 1950 and in 1951 a high grade tabular sandstone deposit in Permian sediments had been discovered in the Apusani mountains of the West Carpathians. Subsequent work lead to the discovery of additional deposits in this area and established a uranium province in the Western Carpathians. Further uranium provinces were outlined in the Banat mountains as well as in the Eastern Carpathians. The Reasonably Assured Resources of Romania, unassigned to any cost category are estimated at 18,000 tonnes U. The current uranium production is about 200,000 tonnes of ore mined by underground methods. The production centres are located in the three uranium provinces. Due to the unfavorable geological conditions the uranium production costs are considered high. (author). 1 map.

2634 (IAEA-TECDOC–650, pp. 43-48) **How finite are the uranium resources in South Africa?.** Hambleton-Jones, B.B. (Atomic Energy Corp. of South Africa Ltd., Pretoria (South Africa)); Ainslie, L.C.; Andreoli, M.A.G. International Atomic Energy Agency, Vienna (Austria); Nuclear Energy Agency, 75 - Paris (France). Jun 1992. (CONF-9108224–: Technical committee meeting on new developments in uranium exploration, resources, production and demand, Vienna (Austria), 26-29 Aug 1991). In *New developments in uranium exploration, resources, production and demand: Proceedings of a technical committee meeting held in Vienna, 26-29 August 1991.* 258p. Order Number DE93607128. Source: OSTI; NTIS (US Sales Only); INIS.

In South Africa, uranium is in all instances mined as a by-product, the major portion being produced from the gold mines of the Witwatersrand basin. The stagnation of the gold price over the past three years and the likelihood of it continuing for the next three years, engenders limited optimism in the industry. Uranium in particular, because of its low price, is already suffering in the rationalization process taking place in the gold mines. Gold production is falling steadily making uranium the inevitable casualty. As an alternative source of uranium, attention is being refocused on the Karoo formations which are the only other potentially viable

sources of uranium in South Africa outside the Witwatersrand Basin. Factors being re-examined are influences of stratigraphy, source areas, tectonics and volcanism on the distribution of uranium. Lesser attention is being given to uranium mineralization in the Namaqualand Metamorphic Complex which has associated monazitic ores. (author). 4 refs, 9 figs, 2 tabs.

2635 (IAEA-TECDOC–650, pp. 49-58) **Unconformity-related uranium-gold deposits of northern Australia: Resources, genesis and exploration.** Wilde, A.R. (BHP Minerals, Hawthorn, Victoria (Australia). Exploration Dept.). International Atomic Energy Agency, Vienna (Austria); Nuclear Energy Agency, 75 - Paris (France). Jun 1992. (CONF-9108224–: Technical committee meeting on new developments in uranium exploration, resources, production and demand, Vienna (Austria), 26-29 Aug 1991). In *New developments in uranium exploration, resources, production and demand: Proceedings of a technical committee meeting held in Vienna, 26-29 August 1991.* 258p. Order Number DE93607128. Source: OSTI; NTIS (US Sales Only); INIS.

Australia has a uranium resource of 370 kt U_3O_8 (313 kt U) contained in unconformity-related deposits. Over 85% of this resource is located in the Alligator Rivers Province of the Northern Territory. In addition to uranium, several of the deposits here contain economic gold (38t have so far been delineated) and two contain major amounts of platinum-group metals. Uranium-gold deposits of the Alligator Rivers Provinces are in many ways similar to deposits of the Athabasca Basin in Saskatchewan (Canada). They are located at the unconformity between Mid Proterozoic clastic rocks and older metamorphic basement. Ore is associated with fault zones which in some cases transgress and offset the unconformity. Ore is enveloped by intense clay-sized phyllosilicate alteration haloes. Differences (i.e. lower grade, no ore in sandstone, no Ni-Co-As ore) can largely be attributed to the effects of extensive erosion and weathering which has exposed the Alligator Rivers deposits, and overall lack of exploration in areas of thick sandstone cover. All the known deposits in the Alligator Rivers Province were discovered by relatively simple airborne or ground radiometric surveys. Modern, geophysical methods as are routinely employed in Saskatchewan (such as airborne TEM), have not been tried in the Alligator Rivers Province. There has been a paucity of exploration in the Alligator Rivers Province in the past 15 years, as a result of creation of a national park over the most prospective area. (author). 31 refs, 8 figs, 2 tabs.

2636 (IAEA-TECDOC–650, pp. 58-64) **Uranium potential of the younger granites of Egypt.** Hussein, H.A.M. (Nuclear Materials Authority, Cairo (Egypt)); Sayyah, T.A. International Atomic Energy Agency, Vienna (Austria); Nuclear Energy Agency, 75 - Paris (France). Jun 1992. (CONF-9108224–: Technical committee meeting on new developments in uranium exploration, resources, production and demand, Vienna (Austria), 26-29 Aug 1991). In *New developments in uranium exploration, resources, production and demand: Proceedings of a technical committee meeting held in Vienna, 26-29 August 1991.* 258p. Order Number DE93607128. Source: OSTI; NTIS (US Sales Only); INIS.

The post-tectonic Pan-African younger granites of Egypt are characterized by abnormal radioactivity. Several plutons of these granites in the Eastern Desert, host a variety of rare metal mineralizations including uranium. Two younger granite plutons, namely El Missikat and El Erediya, in the central part of the Eastern Desert, host siliceous vein-type uranium mineralization, which is structurally controlled by faults and their feather joints associated with NE and NNE trending shear zones. The Gattar granite pluton, at the northern part of the Eastern Desert, hosts vein-type uranium mineralization associated with molybdenite. At the southern part of the Eastern Desert, Um Ara granite pluton hosts uranium as disseminated unconformity contact type. Pitchblende is the primary mineral, while secondary uranium minerals are mainly: uranophane, β-uranophane, soddyite and renardite. Small amounts of pyrite, chalcopyrite, galena, sphalerite, molybdenite and violet fluorite are present in association with the uranium mineralization in the mineralized zones. Present data suggest an origin by hydrothermal fluids derived from the granitic magma. Redistribution by circulating meteoric water may have taken place as evidenced by widespread alteration, particularly silicification. Exploratory mining resulted in clarifying the possibility of the extension of the uranium mineralization zone laterally and in depth. The estimation of the uranium potentiality of the four younger granite plutons is 14000 tons uranium as speculative resources. (author). 25 refs, 1 fig., 1 tab.

2637 (IAEA-TECDOC–650, pp. 65-81) **Uranium occurrences in Shaba, Zaire.** Francois, A.P. International Atomic Energy Agency, Vienna (Austria); Nuclear Energy Agency, 75 - Paris (France). Jun 1992. (CONF-9108224–: Technical committee meeting on new developments in uranium exploration, resources, production and demand, Vienna (Austria), 26-29 Aug 1991). In *New developments in uranium exploration, resources, production and demand: Proceedings of a technical committee meeting held in Vienna, 26-29 August 1991.* 258p. Order Number DE93607128. Source: OSTI; NTIS (US Sales Only); INIS.

Besides the famous Shinkolobwe Mine, many other uranium ore occurrences are known in Shaba. Nearly all of them are closely linked to the two Cu-Co stratabound ore-formations located at the lower part of the R.2 Group. This Group belongs to the Roan Supergroup, i.e. to the lower part of the Katanga System, dated late Proterozoic. The R.2 Group occurs as huge "fragments" of dolomiticopsammitic rocks, included in a silty brecciated matrix. The whole forms a kind of megabreccia, possibly formed by creeping and dissolution of evaporitic thick beds, during important tectonic movements. A stratiform poor proto-ore, probably syngenetic, is observed at the bottom of the lower Cu-Co ore-formation, linked to a marked redox contact, the first observed in the Katanga System. Locally, in some R.2 fragments, this proto-ore was remobilized in veinlets of uraninite. Superficial weathering could result in hexavalent uranium minerals, scattered in the vicinity of the orebody. Ores of economic grade (appr. 0.3% U3O8) and tonnage (500 to 3,000 tons U3O8) may result from these changes. Shinkolobwe is an exception, considering the high U3O8 tonnage. It is conjectured that the ore came from uranium previously hosted in several deep seated R.2 fragments, leached by hot brines. Shinkolobwe is practically mined out. Nevertheless, a significant amount of U3O8 (100 to 200 tons ?) has been and is still extracted yearly from other mines with the Cu-Co ores. It has been and is still lost, due to mining and metallurgical problems. It could perhaps be recovered in the future. Meanwhile, it should be interesting to carefully pile the extracted uranium ores and the uranium-bearing iron precipitate. Some new exploration attempts should be undertaken in the future, with the aim of finding new uranium deposits. (author). 15 refs, 11 figs, 1 tab.

2638 (IAEA-TECDOC–650, pp. 81-88) **Case histories and new areas for uranium exploration in Bulgaria.** Simov, S.D. (Committee of Geology of Bulgaria, Sofia (Bulgaria)); Bojkov, I.B. International Atomic Energy Agency, Vienna (Austria); Nuclear Energy Agency, 75 - Paris (France). Jun 1992. (CONF-9108224–: Technical committee meeting on new developments in uranium exploration, resources, production and demand, Vienna (Austria), 26-29 Aug 1991). In *New developments in uranium exploration, resources, production and demand: Proceedings of a technical committee meeting held in Vienna, 26-29 August 1991.* 258p. Order Number DE93607128. Source: OSTI; NTIS (US Sales Only); INIS.

Uranium exploration started in Bulgaria in 1945 and in 1946 a Soviet-Bulgarian Joint Venture was formed for the continuation of these activities. The first deposits were discovered during the late fifties. During 45 years of exploration the entire territory of Bulgaria (110,000 km^2) was covered by Geiger Muller airborne gamma-ray surveys, and 80% of the territory by ground gamma-ray surveys. More than 18 million metes boreholes were drilled and 640 km galleries were constructed. As a result 35 deposits were discovered during the past 45 years. Some of these deposits such as Buhovo, Eleshnitza and Momino are districts consisting of several deposits. They are of medium size deposits with measured reserves between 5,000-20,000 t U. The remaining 32 deposits are small containing up to 5,000 t U. Seven deposits are currently in exploration stage, 14 in production and 14 are depleted. Two plants process the ore from vein deposits at Buhovo and from sandstone deposits at Eleshnitza in southwestern Bulgaria. The capacity of the plants is sufficient to process the entire ore production as well as the loaded resins from in-situ leaching operations. The latter

technique is widely used and 70% of the uranium is recovered by this method. 75% of the reserves occur in sandstone type deposits. High grade ore was mined from vein deposits such as Buhovo, Partisanska Poliana, Beli Iskar, and Smolian. The reserves, the capacity of the mines and ore processing plants are sufficient to meet the uranium requirements to fuel the 6 operating nuclear reactors with a total installed electricity generating capacity of 3,54 GWe. (author). 4 refs, 10 figs, 3 tabs.

2639 (IAEA-TECDOC–650, pp. 115-117) **Main types of uranium mineralization and uranium exploration in Viet Nam.** Nguyen Van Hoai (Ministry of Heavy Industries of Viet Nam, Hanoi (Viet Nam). Geological Dept.); Phan Van Quynh. International Atomic Energy Agency, Vienna (Austria); Nuclear Energy Agency, 75 - Paris (France). Jun 1992. (CONF-9108224–: Technical committee meeting on new developments in uranium exploration, resources, production and demand, Vienna (Austria), 26-29 Aug 1991). In *New developments in uranium exploration, resources, production and demand: Proceedings of a technical committee meeting held in Vienna, 26-29 August 1991.* 258p. Order Number DE93607128. Source: OSTI; NTIS (US Sales Only); INIS.

In Viet Nam, where uranium exploration started before the National Independence, a number of occurrences have been discovered. They belong to the sandstone, vein, volcanic, metamorphic and surficial deposit types. In addition, coal seams have been found to be uraniferous. Uranium resources have been classified as follows: 200 tonnes U as EAR-I, recoverable at costs between US$ 80-130/kg U, 200 tonnes U as EAR-II, recoverable at costs between US$ 80-130/Kg U, and 180,000 tonnes U as Speculative Resources, of which 100,000 tonnes are believed to be recoverable at costs of below US$ 80/kg U and the remaining 80,000 tonnes at above US$ 130/kg U. (author). 1 map, 1 tab.

2640 (IAEA-TECDOC–650, pp. 128-136) **SERMINE: A software for ore deposits exploration and estimation.** Benac, J.P. (Compagnie Generale des Matieres Nucleaires (COGEMA), 78 - Velizy-Villacoublay (France)); Delorme, D.; Demange, C.; Sanguinetti, H. International Atomic Energy Agency, Vienna (Austria); Nuclear Energy Agency, 75 - Paris (France). Jun 1992. (CONF-9108224–: Technical committee meeting on new developments in uranium exploration, resources, production and demand, Vienna (Austria), 26-29 Aug 1991). In *New developments in uranium exploration, resources, production and demand: Proceedings of a technical committee meeting held in Vienna, 26-29 August 1991.* 258p. Order Number DE93607128. Source: OSTI; NTIS (US Sales Only); INIS.

SERMINE is a Cogema software built in response to internal needs and has currently been used for seven years in exploration, mining survey and estimations. SERMINE integrates a complete and coherent chain of programs whose application fields range from acquisition of basic data describing orebodies to the most advanced geostatistical estimations and simulations, with the continuous assistance of graphical displays. The system is user friendly, integrated, open and efficient. (author). 9 figs.

2641 (IAEA-TECDOC–650, pp. 136-146) **Recoverable reserves estimation using SERMINE software: Case histories.** Demange, C. (Compagnie Generale des Matieres Nucleaires (COGEMA), 78 - Velizy-Villacoublay (France)); Sans, H. International Atomic Energy Agency, Vienna (Austria); Nuclear Energy Agency, 75 - Paris (France). Jun 1992. (CONF-9108224–: Technical committee meeting on new developments in uranium exploration, resources, production and demand, Vienna (Austria), 26-29 Aug 1991). In *New developments in uranium exploration, resources, production and demand: Proceedings of a technical committee meeting held in Vienna, 26-29 August 1991.* 258p. Order Number DE93607128. Source: OSTI; NTIS (US Sales Only); INIS.

Two case studies illustrate the use of the Service Variables method for the estimation of local recoverable reserves. In the first one the estimation of a deposit can be followed step by step. In the second one the estimation and production figures are compared and the discrepancies analysed. (author). 2 refs, 15 figs.

2642 (IAEA-TECDOC–650, pp. 147-152) **The Cerro Solo Project.** Navarra, P.R. (Comision Nacional de Energia Atomica, Godoy Cruz (Argentina)). International Atomic Energy Agency, Vienna (Austria); Nuclear Energy Agency, 75 - Paris (France). Jun 1992. (CONF-9108224–: Technical committee meeting on new developments in uranium exploration, resources, production and demand, Vienna (Austria), 26-29 Aug 1991). In *New developments in uranium exploration, resources, production and demand: Proceedings of a technical committee meeting held in Vienna, 26-29 August 1991.* 258p. Order Number DE93607128. Source: OSTI; NTIS (US Sales Only); INIS.

The objective of the Cerro Solo Project, which was initiated in 1990, is to perform the assessment of the Co. Solo uranium ore deposit in a sequential manner. The deposit, which is located in the Patagonia Region, Argentine Republic, belongs to the sandstone type, and to the subtype coarse-grained, high energy stream. Uranium occurrences are peneconcordant, lenticular shaped and irregularly distributed in the fluvial sediments of the cretaceous Chubut Group. Resources estimated using up to present data, in tonnes of uranium recoverable at costs up to $80/kg U, are: Reasonable Assured Resources (RAR): 300 tU; Estimated Additional Resources - Category I (EAR-I): 900 tU; Estimated Additional Resources - Category II (EAR-II): 2400 tU. Resources of this ore deposit are significant to the uranium requirements in Argentina. (author). 3 refs, 6 figs.

2643 (IAEA-TECDOC–650, pp. 169-172) **Geological features and new development of the Xiashuang uranium ore field in south China.** Shen Feng (China National Nuclear Corp., Beijing (China). Bureau of Geology); Pan Yongzheng; Gong Zhigen; Rong Jiashu. International Atomic Energy Agency, Vienna (Austria); Nuclear Energy Agency, 75 - Paris (France). Jun 1992. (CONF-9108224–: Technical committee meeting on new developments in uranium exploration, resources, production and demand, Vienna (Austria), 26-29 Aug 1991). In *New developments in uranium exploration, resources, production and demand: Proceedings of a technical committee meeting held in Vienna, 26-29 August 1991.* 258p. Order Number DE93607128. Source: OSTI; NTIS (US Sales Only); INIS.

Granite-related vein type uranium deposits are of the main uranium type in China. Xiazhuang uranium ore field, a typical one among them, lies in uranium-enriched two-mica granites in the eastern part of Guidong massif, south China. Within the two-mica granites, diabase dykes and later formed silicified fracture zones of different trend occur in swarms, which have roughly the same distance to each other respectively. Pitchblende-bearing microquartz veins are usually concentrated in the location where diabase dykes are intersected by microquartz veins and in the vicinity of contact zone of two-mica granites with muscovite granites. Several deposits are also found in the exocontact zone and in the overlying red basins as well. The development process of the ore field with the advancement of one's knowledge is emphasized. (author). 1 fig.

2644 (IAEA-TECDOC–650, pp. 172-187) **Uranium resources of the Union of Soviet Socialist Republics.** Laverov, N.P. (AN SSSR, Moscow (Russian Federation)); Velichkin, V.I.; Vetrov, V.I.; Krotkov, V.V.; Lapin, A.L; Naumov, S.S.; Pelminev, M.D.; Shumilin, M.V. International Atomic Energy Agency, Vienna (Austria); Nuclear Energy Agency, 75 - Paris (France). Jun 1992. (CONF-9108224–: Technical committee meeting on new developments in uranium exploration, resources, production and demand, Vienna (Austria), 26-29 Aug 1991). In *New developments in uranium exploration, resources, production and demand: Proceedings of a technical committee meeting held in Vienna, 26-29 August 1991.* 258p. Order Number DE93607128. Source: OSTI; NTIS (US Sales Only); INIS.

The paper presents a first overview over the uranium resources of the USSR. The areas where resources occur are referred to as "uranium-ore areas" and "uranium-bearing areas", the difference being the confidence level of the resource estimates and consequently, the resource development. A total of nine uranium-ore areas and six uranium-bearing areas are described as regards their geological environments, deposit types and uranium resources according to their resource category and cost category. In addition the distribution of the total uranium resources recoverable at costs of up to $ 120/kg U, by deposit type is described. (author). 13 figs, 14 tabs.

2645 (IAEA-TECDOC–650, pp. 187-188) **Complex of geophysical methods for reconnaissance of uranium deposits and radiological investigation.** Luchin, I.A. (Ministry of Geology of the USSR, Leningrad (Russian Federation)). International Atomic Energy Agency, Vienna (Austria); Nuclear Energy Agency, 75 - Paris (France). Jun 1992. (CONF-9108224–: Technical committee meeting on new developments in uranium exploration, resources, production and demand, Vienna (Austria), 26-29 Aug 1991). In *New developments in uranium exploration, resources, production and demand: Proceedings of a technical committee meeting held in Vienna, 26-29 August 1991.* 258p. Order Number DE93607128. Source: OSTI; NTIS (US Sales Only); INIS.

An overview over the application of complex, i.e. integrated geophysical methods in the USSR is provided. They are being used for exploration, resource assessment as well as for the detection and monitoring of technogenic fall-out of radionuclides. In detail, these complex geophysical methods include aerogeophysical survey methods, surface gamma/gamma spectrometer methods, hydrolithogeochemical methods, as well as down-hole and ground gamma methods combined with instant fission electron detection and other nuclear methods. (author).

2646 (IAEA-TECDOC–650, pp. 189-213) **The Sue uranium deposits, Saskatchewan, Canada.** Ey, F. (Minatco Ltd, Calgary, AB (Canada)); Piquard, J.P.; Baudemont, D.; Zimmerman, J. International Atomic Energy Agency, Vienna (Austria); Nuclear Energy Agency, 75 - Paris (France). Jun 1992. (CONF-9108224–: Technical committee meeting on new developments in uranium exploration, resources, production and demand, Vienna (Austria), 26-29 Aug 1991). In *New developments in uranium exploration, resources, production and demand: Proceedings of a technical committee meeting held in Vienna, 26-29 August 1991.* 258p. Order Number DE93607128. Source: OSTI; NTIS (US Sales Only); INIS.

The Sue uranium deposits occur in northern Saskatchewan at the eastern edge of the Athabasca Basin. They were discovered from 1988 to 1989 by Minatco Limited, operator of the former Wolly Joint Venture (Inco Limited, Canadian Occidental Petroleum Ltd. and Minatco Limited). These deposits have been named in order of discovery: Sue A, Sue B (1988), Sue C and Sue CQ (1989). Although all the Sue deposits belong to the same trend, their geological settings differ. Sue A is hosted in the sandstones at the unconformity with little to no mineralization in the basement. The particularity of the Sue B orebody is to display perched mineralization i.e. high up in the sandstones, to within 8m of the surface. Sue C and CQ are basement hosted orebodies with the U mineralization occurring as a single lens in Sue C forming a multiple lens system in Sue CQ. No mineralization occurs in the sandstones. In all four deposits, the mineralization is related to extensive hydrothermal alteration overprinting the retrograde, regolithic and diagenetic alterations. The high grade core of the orebodies is spatially related to the proximity of the graphite rich pelitic gneisses and is fault controlled. The U mineralization of Sue A and Sue B is characterized by an association of uranium-oxides and Ni-Co arsenides; the Sue C and Sue CQ ore is monometallic. All these deposits have been found using a combination of geophysical techniques. Sue A and Sue B were discovered using ground VLF and HLEM (Max-Min) techniques whereas the Sue C and Sue CQ deposits located 100m off the EM conductor are the result of DC resistivity and I.P. surveys. 33 refs, 28 figs, 3 tabs.

2647 (IAEA-TECDOC–650, pp. 237-241) **Present state and future of the Czechoslovakian uranium industry.** Pluskal, O. (Charles Univ., Prague (Czechoslovakia). Faculty of Sciences). International Atomic Energy Agency, Vienna (Austria); Nuclear Energy Agency, 75 - Paris (France). Jun 1992. (CONF-9108224–: Technical committee meeting on new developments in uranium exploration, resources, production and demand, Vienna (Austria), 26-29 Aug 1991). In *New developments in uranium exploration, resources, production and demand: Proceedings of a technical committee meeting held in Vienna, 26-29 August 1991.* 258p. Order Number DE93607128. Source: OSTI; NTIS (US Sales Only); INIS.

The situation as regards uranium exploration and production, carried out by the state-owned Czechoslovak Uranium Industry (CSUI) is briefly described. Within the geological environments of the CSFR, the Bohemian Massif has proved to have the best uranium potential, concentrated mainly in the Variscan basement. The uranium potential of the Bohemian Massif is estimated to be in the range of 250,000 to 300,000 tonnes U, of which about 100,000 tonnes U have been recovered. About 80 percent of the total potential is in vein type deposits, the remainder in sandstone type deposits. In the past, six uranium provinces in the Bohemian Massif have been exploited: Pribran, Western Moravia, Western Bohemia, Jachymov, Horni Slavkov and the Northern Bohemian Cretaceous basin. In the future, it is expected that the only district which remains in production, will be the Northern Bohemian Cretaceous basin. (author).

2648 (IAEA-TECDOC–650, pp. 214-224) **Field test for in situ leach mining of uranium in Pakistan.** Moghal, M.Y. (Atomic Energy Minerals Centre, Lahore (Pakistan)). International Atomic Energy Agency, Vienna (Austria); Nuclear Energy Agency, 75 - Paris (France). Jun 1992. (CONF-9108224–: Technical committee meeting on new developments in uranium exploration, resources, production and demand, Vienna (Austria), 26-29 Aug 1991). In *New developments in uranium exploration, resources, production and demand: Proceedings of a technical committee meeting held in Vienna, 26-29 August 1991.* 258p. Order Number DE93607128. Source: OSTI; NTIS (US Sales Only); INIS.

A number of small sized uranium ore bodies have been delineated in Siwalik group of rocks in Bannu District in the northwestern part of Pakistan. The host sandstone is very soft and unconsolidated which makes it difficult to mine the ore body by conventional mining methods. The Kubul Khel ore body meets most of the suitability criteria for insitu leach mining. The result of laboratory leaching tests on the ore body were also encouraging. A field test of insitu leach mining of uranium in Pakistan has therefore been undertaken, using a mixture of sodium carbonate and sodium bicarbonate as lixiviant. The amenability of the uranium ore body to carbonate leaching has been proved and the leaching efficiency increases with the use of hydrogen peroxide as oxidant, along with the lixiviant. The overall cost of production can be significantly reduced by substituting hydrogen peroxide with oxygen as lixiviant. (author). 2 refs, 7 figs, 3 tabs.

2649 (IAEA-TECDOC–650, pp. 224-231) **Uranium mining in Thuringia and Saxony.** Richter, H. (SDAG Wismut, Chemnitz (Germany)); Muehlstedt, P. International Atomic Energy Agency, Vienna (Austria); Nuclear Energy Agency, 75 - Paris (France). Jun 1992. (CONF-9108224–: Technical committee meeting on new developments in uranium exploration, resources, production and demand, Vienna (Austria), 26-29 Aug 1991). In *New developments in uranium exploration, resources, production and demand: Proceedings of a technical committee meeting held in Vienna, 26-29 August 1991.* 258p. Order Number DE93607128. Source: OSTI; NTIS (US Sales Only); INIS.

Its cumulative production of 216,500 t of uranium made the former GDR rank prominently among the world's leading uranium-producing countries. Prospection, exploration and exploitation were carried out by a Soviet-German stock corporation, SDAG Wismut. Five different types of deposits were developed. Of a major economic importance were deposits of the "Ronneburg" type in Lower Palaeozoic shales, limestones and diabases (Eastern Thuringia) as well as hydrothermal vein deposits in granite exocontact (Western Erzgebirge). More than 86 percent of the uranium was mined underground. Among the methods used were both conventional mining methods (shrinkage stoping, room and pillar, roomwork, sublevel caving and sublevel stoping with cemented fill) and underground in-situ leaching as well as surface heap leaching. Due to low prices for uranium on the world market and to cessation of uranium imports by the USSR, the mines will be closed, decommissioned and the sites reclaimed. (author). 7 refs, 8 figs, 4 tabs.

2650 (INIS-BR–2938, pp. 19) **Brazilian uranium occurrences in Gondwana sequences.** Santos, L.C.S. (NUCLEBRAS, Rio de Janeiro, RJ (Brazil)); Saad, S.; Hassano, S. Sao Paulo Univ., SP (Brazil). Inst. de Geociencias. 1988. 156p. (CONF-8807219–: 7. Gondwana symposium, Sao Paulo (Brazil), 18 Jul 1988). In *Proceedings of the 7. Gondwana Symposium - Abstracts.*

Order Number DE93606510. Source: OSTI; NTIS (US Sales Only); INIS.

Published in summary form only. URANIUM RESERVES/mineralization; BRAZIL; CLAYS; GEOLOGIC STRUCTURES; IRON HYDROXIDES; PHOSPHATES; SANDSTONES; URANINITES; MINERALIZATION; URANOCIRCITE

2651 (INIS-BR–2938, pp. 20) **Uranium and molybdenum occurrences in the Beaufort group of the main Karoo Basin, South Africa.** Cole, D.I. (Geological Survey, Bellville (South Africa)); Wipplinger, P.E. Sao Paulo Univ., SP (Brazil). Inst. de Geociencias. 1988. 156p. (CONF-8807219–: 7. Gondwana symposium, Sao Paulo (Brazil), 18 Jul 1988). In *Proceedings of the 7. Gondwana Symposium - Abstracts.* Order Number DE93606510. Source: OSTI; NTIS (US Sales Only); INIS.

Published in summary form only. MOLYBDENUM/reserves; MOLYBDENUM/sandstones; URANIUM RESERVES/sandstones; AFRICA; CLAYS; COFFINITE; MOLYBDENUM; RESERVES; SANDSTONES; MOLYBDENUM ORES; NATURAL OCCURRENCE; PROSPECTING; URANINITES

2652 (INIS-BR–2950) **Determination of the radioactive aerosols transport coefficients generated in open pit uranium mining areas.** Azevedo Py Junior, D. de. Instituto Militar de Engenharia (IME), Rio de Janeiro, RJ (Brazil). 1978 116p. (In Portuguese). Order Number DE93607129. Source: OSTI; NTIS (US Sales Only); INIS.

The classical atmospheric transport model is applied to uranium mining operations. Among the transport parameters there is one concerned with radioactive decay, but it does not include the radioactive decay series which is the specific case for uranium. Therefore, an extension of the transport theory is developed and tested, giving results greater than the ones obtained with the classical model, as expected. (author).

0504 Feed Processing

Refer also to citation(s) 3759, 3761

2653 (DOE/IG–0315) **Followup on audit of depleted uranium metal production at the Fernald Environmental Management Project, Fernald, Ohio.** USDOE Office of Inspector General, Oak Ridge, TN (United States). Eastern Regional Audit Office. 23 Sep 1992. 14p. Sponsored by USDOE, Washington, DC (United States). Source: OSTI (Free of Charge); INIS.

Report to The Secretary.

On November 29, 1989, the Department of Energy's (DOE) Office of Inspector General issued audit report No. DOE/IG-0277, "Depleted Uranium Metal Production at Feed Materials Production Center, Fernald, Ohio." The audit concluded that DOE could save about $101 million by (1) completing a program to qualify commercial vendors to produce depleted uranium metal, (2) preproducing depleted uranium for future years, and (3) cancelling planned capital expenditures for projects not required for preproduction. The purpose of the current audit was to follow up on the previous audit report recommendations to determine whether corrective actions were taken and the intended results were achieved. Management adequately addressed most of the prior audit report recommendations that resulted in cost avoidances of $119.3 million. However, all planned capital expenditures for production processes were not cancelled, and a Fernald site development plan was not completed. This was attributed to not developing an action plan to implement prior audit report recommendations. As a result, $17.5 million was spent during Fiscal Years 1990 and 1991 for the purchase and installation of production equipment that will never be used for production at Fernald. Management concurred with the findings and recommendations. Details of the findings are the subject of Part II of the report. Management and auditor comments are in Part III.

2654 (INIS-BR–2984) **Transformation of thorium sulfate in thorium nitrate by ion exchange resin.** Pereira, W. Instituto de Pesquisas Energeticas e Nucleares (IPEN), Sao Paulo, SP (Brazil). 1991 86p. (In Portuguese). Order Number DE93606678. Source: OSTI; NTIS (US Sales Only); INIS.

A procedure for transforming thorium sulfate into thorium nitrate by means of a strong cationic ion exchanger is presented. The thorium sulfate solution (approximately 15 g/L Th $(SO_4)_2$) is percolate through the resin and the column is washed first with water, with a 0,2 M N H_4 OH solution and then with a 0.2 M N H_4 NO_3 solution in order to eliminate sulfate ion. Thorium is eluted with a 2 M solution of $(N H_4)_2 CO_3$. This eluate is treated with a solution of nitric acid in order to obtain the complete transformation into Th $(NO_3)_4$. The proposed procedure leads to good quality thorium nitrate with high uranium decontamination. (author).

2655 (INIS-BR–3038) **Continuous precipitation of uranium peroxide in process pilot plant.** Quinelato, A.L. Pontificia Univ. Catolica do Rio de Janeiro, RJ (Brazil). Dept. de Ciencia dos Materiais e Metalurgia. 1990 139p. (In Portuguese). Order Number DE93606679. Source: OSTI; NTIS (US Sales Only); INIS.

An experimental study on uranium peroxide precipitation has been carried out with the objective to evaluate the influence of the main process parameters with a technological approach. The uraniferous solution used was obtained from the hydrometallurgical processing of an ore from Itataia - CE. Studies were developed in two distinct experimental stages. In the first stage, the precipitation was investigated by means of laboratory batch tests and, in the second stage, by means of continuous operation in a process pilot plant. (author).

2656 (SER/CDM–29) **Adsorption of uranium contained in industrial phosphoric acid on to Algerian bentonite Part II : Kinetic study.** Chegrouche, Salah (Centre de Developpement des Materiaux, Algiers (Algeria). Lab. d'Analyse); Mellah, Abdelhamid; Berkani, Zouhir; Khelifi, Abderahmane. Secretariat d'Etat a la Recherche, Algiers (Algeria); Centre de Developpement des Materiaux, Algiers (Algeria). Sep 1992. 14p. (In French). Order Number DE93606680. Source: OSTI; NTIS (US Sales Only); INIS.

The purpose of this work is the study of a certain number of physical parameters such as : speed agitation temperature, solid/liquid ratio etc... on the adsorption kinetic of uranium contained in the industrial phosphoric acid of ANNABA (East of Algeria) by Algerian bentonite.

0505 Uranium Enrichment

Refer also to citation(s) 4185

2657 (K/GDP/SAR–3/R1) **Overview of seismic considerations at the Paducah Gaseous Diffusion Plant.** Hunt, R.J.; Stoddart, W.C.; Burnett, W.A.; Beavers, J.E. Oak Ridge K-25 Site, TN (United States). Oct 1992. 10p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OT21400. Order Number DE93002114. Source: OSTI; NTIS; INIS; GPO Dep.

This paper presents an overview of seismic considerations at the Paducah Gaseous Diffusion Plant (PGDP), which is managed by Martin Marietta Energy Systems, Inc., for the Department of Energy (DOE). The overview describes the original design, the seismic evaluations performed for the Safety Analysis Report (SAR) issued in 1985, and current evaluations and designs to address revised DOE requirements. Future plans to ensure changes in requirements and knowledge are addressed.

0507 Fuels Production and Properties

Refer also to citation(s) 2671, 2672, 2673, 2674, 2675, 2676, 2677, 3030, 3154, 3155, 3156, 3157, 3159, 3161, 3162, 3163, 3164, 3165, 3167, 3817

2658 (HW–41205-Del.) **Hanford Atomic Products Operation monthly report, January 1956.** General Electric Co., Richland, WA (United States). Hanford Atomic Products Operation. 24 Feb 1956. 443p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE93002502. Source: OSTI; NTIS (US Sales Only); GPO Dep.

This is the monthly report for the Hanford Atomic Laboratories Products Operation, February, 1956. Metallurgy, reactor fuels, chemistry, dosimetry, separation processes, reactor technology, financial activities, visits, biology operation, physics and instrumentation research, and employee relations are discussed.

2659 (HW–49419-Del.) **Hanford Laboratories Operation monthly activities report, March 1957.** Albaugh, E.W. General Electric Co., Richland, WA (United States). Hanford Atomic Products Operation. 15 Apr 1957. 131p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE93001331. Source: OSTI; NTIS (US Sales Only); GPO Dep.

This is the monthly report of the Hanford Laboratories Operation, March, 1957. Metallurgy, reactor fuels, chemistry, dosimetry, separation processes, reactor technology, financial activities, visits, biology operation, physics and instrumentation research, and employee relations are discussed.

2660 (HW–49752-Del.) **Hanford Laboratories Operation monthly activities report, April 1957.** General Electric Co., Richland, WA (United States). Hanford Atomic Products Operation. 15 May 1957. 138p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE93002087. Source: OSTI; NTIS (US Sales Only); GPO Dep.

This is the monthly report for the Hanford Laboratories Operation, May 1957. Metallurgy, reactor fuels, chemistry, dosimetry, separation processes, reactor technology, financial activities, visits, biology operation, physics and instrumentation research, and employee relations are discussed.

2661 (HW–51234-Del.) **Hanford Laboratories Operation monthly activities report, June 1957.** General Electric Co., Richland, WA (United States). Hanford Atomic Products Operation. 15 Jul 1957. 153p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE93000998. Source: OSTI; NTIS (US Sales Only); GPO Dep.

This is the monthly report for the Hanford Laboratories Operation, July 1957. Metallurgy, reactor fuels, chemistry, dosimetry, separation processes, reactor technology, financial activities, visits, biology operation, physics and instrumentation research, and employee relations are discussed.

2662 (HW–52303-Del.) **Hanford Laboratories Operation monthly activities report, August 1957.** General Electric Co., Richland, WA (United States). Hanford Atomic Products Operation. 15 Sep 1957. 147p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE93001776. Source: OSTI; NTIS (US Sales Only); GPO Dep.

This is the monthly report for the Hanford Laboratories Operation, September 1957. Metallurgy, reactor fuels, chemistry, dosimetry, separation processes, reactor technology, financial activities, visits, biology operation, physics and instrumentation research, and employee relations are discussed.

2663 (HW–62012) **Hanford Laboratories Operation monthly activities report, September 1959.** General Electric Co., Richland, WA (United States). Hanford Atomic Products Operation. 15 Oct 1959. 177p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE93001778. Source: OSTI; NTIS (US Sales Only); GPO Dep.

This is the monthly report for the Hanford Laboratories Operation, October 1959. Metallurgy, reactor fuels, chemistry, dosimetry, separation processes, reactor technology, financial activities, visits, biology operation, physics and instrumentation research, and employee relations are discussed.

2664 (HW–63303) **Hanford Laboratories Operation monthly activities report, December 1959.** General Electric Co., Richland, WA (United States). Hanford Atomic Products Operation. 15 Jan 1960. 162p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE93001780. Source: OSTI; NTIS (US Sales Only); GPO Dep.

This is the monthly report for the Hanford Laboratories Operation, January 1960. Metallurgy, reactor fuels, chemistry, dosimetry, separation processes, reactor technology, financial activities, visits, biology operation, physics and instrumentation research, and employee relations are discussed.

2665 (HW–64108) **Hanford Laboratories Operation monthly activities report, February 1960.** General Electric Co., Richland, WA (United States). Hanford Atomic Products Operation. 15 Mar 1960. 163p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE93002499. Source: OSTI; NTIS (US Sales Only); GPO Dep.

This is the monthly report for the Hanford Laboratories Operation, February, 1960. Metallurgy, reactor fuels, chemistry, dosimetry, separation processes, reactor technology, financial activities, visits, biology operation, physics and instrumentation research, and employee relations are discussed.

2666 (HW–65854-Del.) **Hanford Laboratories Operation monthly activities report, June 1960.** General Electric Co., Richland, WA (United States). Hanford Atomic Products Operation. 15 Jul 1960. 165p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE93002500. Source: OSTI; NTIS (US Sales Only); GPO Dep.

This is the monthly report for the Hanford Laboratories Operation, July 1960. Metallurgy, reactor fuels, chemistry, dosimetry, separation processes, reactor technology, financial activities,, visits, biology operation, physics and instrumentation research, and employee relations are discussed.

2667 (HW–66960-Del.) **Hanford Laboratories Operation monthly activities report, September 1960.** General Electric Co., Richland, WA (United States). Hanford Atomic Products Operation. 15 Oct 1960. 169p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE93001336. Source: OSTI; NTIS (US Sales Only); GPO Dep.

This is the monthly report for the Hanford Laboratories Operation, October, 1960. Metallurgy, reactor fuels, chemistry, dosimetry, separation processes, reactor technology, financial activities, visits, biology operation, physics and instrumentation research, and employee relations are discussed.

2668 (HW–67532) **Hanford Laboratories Operation monthly activities report, November 1960.** Sale, W. General Electric Co., Richland, WA (United States). Hanford Atomic Products Operation. 15 Dec 1960. 171p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE93001785. Source: OSTI; NTIS (US Sales Only); GPO Dep.

This is the monthly report for the Hanford Laboratories Operation, November 1960. Metallurgy, reactor fuels, chemistry, dosimetry, separation processes, reactor technology, financial activities, visits, biology operation, physics and instrumentation research, and employee relations are discussed.

2669 (HW–67700-Del.) **Hanford Atomic Products Operation annual report, 1960.** German, L.L. General Electric Co., Richland, WA (United States). Hanford Atomic Products Operation. 1 Mar 1961. 31p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE93001232. Source: OSTI; NTIS (US Sales Only); GPO Dep.

This is the annual report (1960) from the Hanford Atomic Products Operation. Various programs are briefly described including production of fuel elements, production reactor operations, reprocessing, criticality research, radiological research activities, reactor materials testing, the plutonium recycle program, and the allocation of resources.

2670 (HW–69062) **Hanford Laboratories Operation monthly activities report, March 1961.** General Electric Co., Richland, WA (United States). Hanford Atomic Products Operation. 15 Apr 1961. 184p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE93002088. Source: OSTI; NTIS (US Sales Only); GPO Dep.

This is the monthly report for the Hanford Laboratories Operation, April 1961. Metallurgy, reactor fuels, chemistry, dosimetry, separation processes, reactor technology, financial activities, visits, biology operation, physics and instrumentation research, and employee relations are discussed.

0508 Spent Fuels Reprocessing

Refer also to citation(s) 2658, 2669, 3065, 3159, 3768, 3770, 3807, 3930

2671 (ARH–62-Del.) **200 Areas Operation monthly report, December 1967.** Atlantic Richfield Hanford Co., Richland, WA

(United States). 22 Jan 1968. 51p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE93002107. Source: OSTI; NTIS (US Sales Only); GPO Dep.

This is the progress report from the Hanford Facility 200 Area Operations for the month of December 1967. Operations described include: Production Planning Section; Purex Section; Plutonium Finishing Section; Waste Management Section; Technical Services Section; CPD Services Section; Research & Engineering Department; Facilities Engineering Department; Finance Department; Industrial Relations and Administration Department; Personnel activities; reports issued; and patent summary.

2672 (ARH–300-Del.) **200 Areas Operation monthly report, January 1968.** Atlantic Richfield Hanford Co., Richland, WA (United States). 22 Feb 1968. 50p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE93002108. Source: OSTI; NTIS (US Sales Only); GPO Dep.

This is the progress report from the Hanford Facility 200 Area Operations for the month of January 1968. Operations described include: Production Planning Section; Purex Section; Plutonium Finishing Section; Waste Management Section; Technical Services Section; CPD Services Section; Research & Engineering Department; Facilities Engineering Department; Finance Department; Industrial Relations and Administration Department; Personnel activities; reports issued; and patent summary.

2673 (ARH–301-Del.) **200 Areas Operation monthly report, February 1968.** Atlantic Richfield Hanford Co., Richland, WA (United States). 22 Mar 1968. 51p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE93002109. Source: OSTI; NTIS (US Sales Only); GPO Dep.

This is the progress report from the Hanford Facility 200 Area Operations for the month of February 1968. Operations described include: Production Planning Section; Purex Section; Plutonium Finishing Section; Waste Management Section; Technical Services Section; CPD Services Section; Research & Engineering Department; Facilities Engineering Department; Finance Department; Industrial Relations and Administration Department; Personnel activities; reports issued; and patent summary.

2674 (ARH–1108-Del.) **200 Areas Operation monthly report, September 1969.** Atlantic Richfield Hanford Co., Richland, WA (United States). 22 Oct 1969. 45p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE93002110. Source: OSTI; NTIS (US Sales Only); GPO Dep.

This is the progress report from the Hanford Facility 200 Area Operations for the month of September 1969. Operations described include: Production Planning Section; Purex Section; Plutonium Finishing Section; Waste Management Section; Technical Services Section; CPD Services Section; Research & Engineering Department; Facilities Engineering Department; Finance Department; Industrial Relations and Administration Department; Personnel activities; reports issued; and patent summary.

2675 (ARH–1506-Del.) **200 Areas Operation monthly report, June 1970.** Atlantic Richfield Hanford Co., Richland, WA (United States). 22 Jul 1970. 55p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE93002111. Source: OSTI; NTIS (US Sales Only); GPO Dep.

This is the progress report from the Hanford Facility 200 Area Operations for the month of June 1970. Operations described include: Production Planning Section; Purex Section; Plutonium Finishing Section; Waste Management Section; Technical Services Section; CPD Services Section; Research & Engineering Department; Facilities Engineering Department; Finance Department; Industrial Relations and Administration Department; Personnel activities; reports issued; and patent summary.

2676 (ARH–1509-Del.) **200 Areas Operation monthly report, September 1970.** Atlantic Richfield Hanford Co., Richland, WA (United States). 20 Oct 1970. 60p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE93002112. Source: OSTI; NTIS (US Sales Only); GPO Dep.

This is the progress report from the Hanford Facility 200 Area Operations for the month of September 1970. Operations described include: Production Planning Section; Purex Section; Plutonium Finishing Section; Waste Management Section; Technical Services Section; CPD Services Section; Research & Engineering Department; Facilities Engineering Department; Finance Department; Industrial Relations and Administration Department; Personnel activities; reports issued; and patent summary.

2677 (ARH–1512-Del.) **200 Areas Operation monthly report, December 1970.** Atlantic Richfield Hanford Co., Richland, WA (United States). 21 Jan 1971. 59p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE93002113. Source: OSTI; NTIS (US Sales Only); GPO Dep.

This is the progress report from the Hanford Facility 200 Area Operations for the month of December 1970. Operations described include: Production Planning Section; Purex Section; Plutonium Finishing Section; Waste Management Section; Technical Services Section; CPD Services Section; Research & Engineering Department; Facilities Engineering Department; Finance Department; Industrial Relations and Administration Department; Personnel activities; reports issued; and patent summary.

2678 (DPST–82-581) **Potential safety-related incidents with possible applicability to a nuclear fuel reprocessing plant.** Durant, W.S.; Perkins, W.C.; Lee, R.; Stoddard, D.H. Savannah River Lab., Aiken, SC (United States). 20 May 1982. 41p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC09-76SR00001 ;AC09-89SR18035. Order Number DE93000473. Source: OSTI; NTIS; GPO Dep.

The Safety Technology Group is developing methodology that can be used to assess the risk of operating a plant to reprocess spent nuclear fuel. As an early step in the methodology, a preliminary hazards analysis identifies safety-related incidents. In the absence of appropriate safety features, these incidents could lead to significant consequences and risk to onsite personnel or to the public. This report is a compilation of potential safety-related incidents that have been identified in studies at SRL and in safety analyses of various commercially designed reprocessing plants. It is an expanded revision of the version originally published as DP-1558, Published December 1980.

2679 (DPW–53-652) **Purification of irradiated U^{235} (summary).** Jenkins, W.A. Du Pont de Nemours (E.I.) and Co., Wilmington, DE (United States). Explosives Dept. 7 Apr 1953. 7p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC09-76SR00001. (SR/H–255). Order Number DE93002721. Source: OSTI; NTIS (US Sales Only); GPO Dep.

After a period of irradiation in the 100 Area reactors to produce tritium, the enriched uranium slugs become inefficient and must be removed for U^{235} recovery. The feasibility of processing these slugs at SRP was investigated. It is concluded that conventional equipment in Buildings 221-F and H may be used for the separation and purification of the U^{235} from the slugs; about 7 hot canyon modules and 18 warm canyon modules will be required. The separation problems and the preliminary plant design are discussed.

2680 (DPW–6803) **Report on SCRUP analysis meeting at Chalk River.** Kelley, H.M. Du Pont de Nemours (E.I.) and Co., Wilmington, DE (United States). Explosives Dept. 12 Dec 1952. 3p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC09-76SR00001. (SR/H–246). Order Number DE93002373. Source: OSTI; NTIS (US Sales Only); GPO Dep.

This memorandum discusses a meeting of representative of AEC, AECL, AED, and ORNL at Chalk River November 20 and 21 to discuss the Canadian and ORNL uranium and plutonium analytical and separations process data on the quantities of plutonium and uranium shipped to Oak Ridge.

2681 (HW–19739) **Chemical Research Section progress report for November 1950.** Hill, O.F.; Leitz, F.J. Hanford Works, Richland, WA (United States). 18 Dec 1950. 19p. Sponsored by

USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE93002496. Source: OSTI; NTIS (US Sales Only); GPO Dep.

Progress reports are presented for the following studies: metal production process; bismuth phosphate process; tributyl phosphate extraction; and tributy phosphate metal recovery process. Metal production process studies include: isolation by precipitation of plutonium(IV) arsenate; isolation by the precipitation of plutonium(III) fluoride; and recovery of plutonium from slag and crucible wastes. Bismuth phosphate process studies include: extraction as a function of the bismuth to plutonium ratio; removal of iodine from dissolver solution; and variations in the concentration cycle. Tributy phosphate extraction studies cover effect of aluminum nitrate on plutonium(IV) extraction. Tributyl phosphate metal recovery process studies cover butyl acid phosphate chemistry.

2682 (HW–54821-Del.) **Chemical Processing Department monthly report, January 1958.** General Electric Co., Richland, WA (United States). Hanford Atomic Products Operation. 21 Feb 1958. 95p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE93002497. Source: OSTI; NTIS (US Sales Only); GPO Dep.

Pu production in separations plants was 107% of forecast. Purex set a new record high for U processed. UO_3O plant produced 94% of forecast; shipments were 120 tons ahead of schedule. Production of unfabricated Pu metal was 112% of forecast and 97% of Jan. schedule. Purex plant prototype anion exchange circulating resin system on 2BP stream was begun and functioned well; metallic impurities was reduced 5× in the Pu product. UO_3 produced from feed(UNH) was started through the production facility. Addition of gelatin to Recuplex dissolver solution produced a clearer solvent feed stream. Other variations, modifications in equipment/processes are described.

2683 (HW–55914-Del.) **Chemical Processing Department monthly report for April 1958.** Warren, J.H. General Electric Co., Richland, WA (United States). Hanford Atomic Products Operation. 21 May 1958. 89p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE93001777. Source: OSTI; NTIS (US Sales Only); GPO Dep.

The separations plants operated on schedule, and Pu production exceeded commitment. UO_3 production and shipments were also ahead of schedule. Purex operation under pseudo two-cycle conditions (elimination of HS and 1A columns, co-decontamination cycle concentrator HCP) was successful. Final U stream was 3× lower in Pu than ever before; γ activity in recovered HNO_3 was also low. Four of 6 special E metal batches were processed through Redox and analyzed. Boric acid is removed from solvent extraction process via aq waste. The filter in Task II hydrofluorinator was changed from carbon to Poroloy. Various modifications to equipment were made.

2684 (HW–62593-Del.) **Chemical Processing Department monthly report for October 1959.** General Electric Co., Richland, WA (United States). Hanford Atomic Products Operation. 20 Nov 1959. 68p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE93001779. Source: OSTI; NTIS (US Sales Only); GPO Dep.

Pu output from separations plant was less than scheduled, but year-to- date production exceeded commitment by 4%. The Palm recovery run in Purex was the most successful to date. UO_3 production and shipments met schedule. Purex had two pump failures. When Purex 1WW was centrifuged and treated to recover Ce, most of it remained in the centrifugate; only 14% was recovered. The prototype Pu ozonator in Redox performed well. Test runs on an acid precycle flowsheet and a proposed internal recycle scheme for Palm recovery were initiated in Redox. Recuplex had a change in solvent extraction feed preparation, and an installation of a safe-geometry bottom section on the stripping column. Storage of Purex 1WW wastes was discussed in a meeting. Conversion of Rexuplex to a manufacturing facility was completed. Cost estimates were developed for several alternative Palmolive processing schemes. Process flow diagrams were completed for Sulfex decladding of Yankee elements and Zirflex decladding of Dresden elements.

2685 (HW–63706-Del.) **Chemical Processing Department monthly report for January 1960.** General Electric Co., Richland, WA (United States). Hanford Atomic Products Operation. 22 Feb 1960. 53p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE93001781. Source: OSTI; NTIS (US Sales Only); GPO Dep.

Production of Pu nitrate, UO_3, and unfabricated Pu metal met schedules. Decontamination performance of Purex process continued below standard. The cerium-144 cask is being redesigned. A "powered ferret", for driving a scintillation counter through a conduit to monitor ground activity beneath waste storage tanks, is being designed.

2686 (HW–64089-Del.) **Chemical Processing Department monthly report for February 1960.** General Electric Co., Richland, WA (United States). Hanford Atomic Products Operation. 21 Mar 1960. 47p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE93001782. Source: OSTI; NTIS (US Sales Only); GPO Dep.

Production Pu nitrate and unfabricated Pu metal during Feb. was below forecast; however FY output is above forecast. Production of UO_3 exceeded commitments; shipments met schedule. Decontamination performance of Purex solvent extraction system was subnormal. Pu nitrate solutions were concentrated. A fire occurred in Purex N Cell during conversion of ion exchange prototype to production facility.

2687 (HW–66958-Del.) **Chemical Processing Department monthly report, September 1960.** General Electric Co., Richland, WA (United States). Hanford Atomic Products Operation. 21 Oct 1960. 52p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE93001335. Source: OSTI; NTIS (US Sales Only); GPO Dep.

A new production record was set for the second successive month. Pu waste losses were higher than normal. U waste losses were normal. Both products were within shipping specifications. Seven radiation occurrences were incurred. Various equipment/process modificationss are described, along with project proposals.

2688 (HW–69803) **Chemical Processing Department monthly report, May 1961.** General Electric Co., Richland, WA (United States). Hanford Atomic Products Operation. 21 Jun 1961. 55p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE93002089. Source: OSTI; NTIS (US Sales Only); GPO Dep.

Production of Pu and U nitrates, U oxides, Pu metal buttons, and fabricated parts are reported. 135 kCi Sr-90 was isoalted in Purex plant and stored for further Sr-89 decay. The new scrub cartridge in Purex co-decontamination cycle column performed better than the old. Increased Np losses were attributed to failure of plastic plates in 2nd cycle U extraction column.

2689 (IAEA-TECDOC–660, pp. 163-172) **Development of the expert system at the Tokai reprocessing plant.** Iwabuchi, H. (Power Reactor and Nuclear Fuel Development Corp., Tokai, Ibaraki (Japan). Tokai Reprocessing Plant); Koshibae, T.; Miura, N. International Atomic Energy Agency, Vienna (Austria). Jul 1992. (CONF-9109435–: Technical committee meeting/workshop on demonstration and review of expert system prototypes, Springfields (United Kingdom), 30 Sep 1991). In *Expert systems in the nuclear industry: Report of a technical committee meeting/workshop held in Springfields, United Kingdom, 30 September - 4 October 1991.* 219p. Order Number DE93606682. Source: OSTI; NTIS (US Sales Only); INIS.

The instruction system and the process simulator are under development at the Tokai Reprocessing Plant to support operation of the major reprocessing process. The instruction system, which has been developed since 1985, is the computer aided system that automatically diagnoses the status of the extraction process and gives proper guidances to the operator when anomalous events are occurred. The process simulator, which has been developed since 1988, covers major reprocessing process such as shearing and dissolution of spent nuclear fuel, clarification and adjustment of dissolver solution and extraction cycles of co-decontamination, separation and purification of Pu and U. (author). 10 figs, 1 tab.

2690 (IPEN-PUB–356) **TBP degradation products. Separation and gas-chromatographic determination.** Kuada, T.A.; Alem, C.M.; Matsuda, H.T.; Araujo, B.F. de; Araujo, J.A de. Instituto de Pesquisas Energeticas e Nucleares (IPEN), Sao Paulo, SP (Brazil). Nov 1991. 21p. (In Portuguese). (CONF-8510519–: 26. Brazilian Congress on Chemistry, Fortaleza (Brazil), 6-11 Oct 1985). Order Number DE93606683. Source: OSTI; NTIS (US Sales Only); INIS.

A separation method for di butylphosphate, mono butylphosphate and phosphoric acid as degradation products in organic and aqueous streams of the process containing variable amounts of actinides and fission products is described. The products were separated by extraction and after methylation the final determination was carried out by gas chromatography. TPP was used as internal standard and 5 to 500 mg/L concentration range was determined with 1 to 10% deviation depending on the concentration of organo phosphates. (author).

2691 (IPEN-PUB–357) **Continuous solvent cleanup in liquid-liquid separation processes.** Goncalves, M.A.; Matsuda, H.T.; Forbicini, S.; Araujo, B.F. de; Araujo, J.A de. Instituto de Pesquisas Energeticas e Nucleares (IPEN), Sao Paulo, SP (Brazil). Nov 1991. 17p. (In Portuguese). (CONF-8510519–: 26. Brazilian Congress on Chemistry, Fortaleza (Brazil), 6-11 Oct 1985). Order Number DE93606684. Source: OSTI; NTIS (US Sales Only); INIS.

In the separation processes for actinides recovery the hydrolytic and radiolytic processes causes a deterioration of the organic phase (TBP/dodecane). So, an integral part of the process must be a solvent scrubbing step for removal of these degradation products, actinides traces and fission products activity. This work deals with a continuous procedure for solvent scrubbing. A four-stage continuous contactor is used for increasing the scrubbing efficiency. Continuous and discontinuous scrubbing efficiencies are compare and Na_2 CO_3 5%/H NO_3 1 M and N_2 H_5 OH/(N_2 H_5)$_2$ CO_3 mixtures are studied as scrubbing agents. (author).

2692 (KAERI/AR–336/91) **Recycling of MOX fuel for LWRs.** Joo, Hyung Kook (Korea Atomic Energy Research Inst., Daeduk (Korea, Republic of)); Oh, Soo Youl. Korea Atomic Energy Research Inst., Daeduk (Korea, Republic of). Jan 1992. 78p. (In Korean). Order Number DE93606685. Source: OSTI; NTIS (US Sales Only); INIS.

The status and issues related to the thermal recycling of reprocessed nuclear fuels have been reviewed. It is focused on the use of reprecessed plutonium in the form of mixed oxide (MOX) for a light water reactor and the review on reprocessing and fabrication processes is beyond the scope. In spite of the difference in the nuclear characteristics between plutonium and uranium isotopes, the neutronics behavior in a core with MOX fuels is similar to that with normal uranium fuels. However, since the neutron spectrum is hardened in a core with MOX, the Doppler, viod, and moderator temperature coefficients become more negative and the control rod and boron worths are slightly reduced. Therefore, the safety will be evaluated carefully in addition to the core neutronics analysis. The MOX fuel rod behavio. related to the rod performance such as the pellet to clad interaction and fission gas release is also similar to that of uranium rods, and no specific problem arises. Substituting MOX fuels for a portion of uranium fuels, it is estimated that the savings be about 25% in uranium ore and 10% in uranium enrichment service requirements. The use of MOX fuel in LWRs has been commercialized in European countries including Germany, France, Belgium, etc., and a demonstration program has been pursued in Japan for the commercial utilization in the late 1990s. Such a worldwide trend indicates that the utilization of MOX fuel in LWRs is a proven technology and meets economics criteria. (Author).

2693 (KAERI-NEMAC/RR–57/91) **A study on the behavior of defective LWR spent fuel.** You, Gil Sung (Korea Atomic Energy Research Inst., Daeduk (Korea, Republic of)); Kim, Eun Ka; Kim, Keon Sik; Suh, Hang Suck; Kim, Seung Jung; Ro, Seung Gy; Park, Chong Mook; Ji, Pyung Gook. Korea Atomic Energy Research Inst., Daeduk (Korea, Republic of). Mar 1992. 107p. (In Korean). Order Number DE93606686. Source: OSTI; NTIS (US Sales Only); INIS.

To investigate the storage behavior of the defective LWR spent fuel rods, the characteristic changes of fuel and cladding are to be measured and analyzed. In addition, the oxidation study in air on non-irradiated and irradiated UO_2 was performed. No changes were observed in the tested fuel rods after 30 month storage. The Cs-134, 137 released rapidly during the initial 3 months of storage, but remained in constant value after 3 month storage and the release was almost ceased after 30 month storage. The weight gain of non-irradiated UO_2 samples showed a trend of S type curves and the activation energies were 11OKJ/mol above 350 deg C. and 143KJ/mol below 350 deg C. But irradiated UO_2 showed a rapid increase at initial stage of oxidation and a decrease at later stage when compared with the results of non-irradiated UO_2. (Author).

2694 **Integrated process for reprocessing spent nuclear fuel.** Forsberg, C.W. To Dept. of Energy. 6 Mar 1991. USAA patent application 7-665,20. 20p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. Order Number DE93002017. Source: OSTI; NTIS; GPO Dep.

This invention is comprised of a process for recovering nuclear fuel from spent fuel assemblies that employs a single canister process container. The cladding and fuel are oxidized in the container, the fuel is dissolved and removed from the container for separation from the aqueous phase, the aqueous phase containing radioactive waste is returned to the container. This container is also the disposal vessel. Add solidification agents and compress container for long term storage.

2695 (UCRL-LR–110870) **Molten salt extraction (MSE) of americium from plutonium metal in $CaCl_2$-KCl-$PuCl_3$ and $CaCl_2$-$PuCl_3$ salt systems.** Dodson, K.E. Lawrence Livermore National Lab., CA (United States). 11 Jun 1992. 53p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. Order Number DE93001623. Source: OSTI; NTIS; INIS; GPO Dep.

Thesis. Submitted to Univ. of California, Davis.

Molten salt extraction (MSE) of americium-241 from reactor-grade plutonium has been developed using plutonium trichloride salt in stationary furnaces. Batch runs with oxidized and oxide-free metal have been conducted at temperature ranges between 750 and 945C, and plutonium trichloride concentrations from one to one hundred mole percent. Salt-to-metal ratios of 0.10, 0.15, and 0 30 were examined. The solvent salt was either eutectic 74 mole percent $CaCl_2$–26 mole percent KCl or pure $CaCl_2$. Evidence of trivalent product americium, and effects of temperature, salt-to-metal ratio, and oxide contamination on the americium extraction efficiency are given. 24 refs, 20 figs, 13 tabs.

2696 (WSRC-TR–92-022) **FB-Line resin testing final report.** Bannochie, C.J. Westinghouse Savannah River Co., Aiken, SC (United States). 23 Jan 1992. 10p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC09-89SR18035. Order Number DE93002692. Source: OSTI; NTIS; GPO Dep.

The Dowex 50W-X8 and 50W-Xl2 resin samples are both strong acid cation materials in the hydrogen form. Each material has a water retention capacity characteristic of its respective marketed degree of cross-linking. Dowex 21K gives confirmatory responses to tests for a strong anion exchange resin in the nitrate form. All three resins have the manufacturer's specified ionic type and form, and the Dowex 50W resins have characteristic water retention capacities. These tests conclude that the ion exchange resins in use in FB-Line meet the approved safety document criteria for cross-linking, ionic form, and resin type.

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Refer also to citation(s) 2739, 2740, 2741, 2752, 3270, 3277, 3437

2697 (CONF-920905–26) **Potential impacts of ICRP 60 and 61 on the transportation regulations.** Rawl, R.R. (Oak Ridge National Lab., TN (United States)); Eckerman, K.F.; Wangler, M.E.; Punch, F.; Carriker, A.W. Oak Ridge National Lab., TN (United States). [1992]. 12p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. From 10. international symposium on the packaging and transportation of radioactive materials: PATRAM '92; Yokohama (Japan); 13-18 Sep 1992. Order Number DE93000446. Source: OSTI; NTIS; INIS; GPO Dep.

The International Commission on Radiation Protection (ICRP) has been providing recommendations for limitations on radiation exposure for decades. The ICRP recommendations address ionizing radiation and are concerned with protecting humans from its effects. These recommendations assist regulatory and advisory agencies in establishing and promulgating national regulations and practices in radiation Protection. Most countries have incorporated at least some aspect of the recommendations in their regulations since about 1956 when the first basic prowdon standard was Published in ICRP 2. Since that time ICRP has issued two major revisions to the recommendations. ICRP 26 was published in 1977 and ICRP 60 was published in 1991. These last two publications have companion works, ICRP 30 atid ICRP 61, that contain Annual Limits of Intake (ALI) for radiation workers. This report discusses the impacts of ICRP 60 and 61 on transport regulations.

2698 (DOE/ID–10387) **Department of Transportation – Exemption for using the Transuranic Package Transporter-I (TRUPACT-I) at the Idaho National Engineering Laboratory (Code of Federal Regulations, Title 49, Part 107, Subpart B – Exemptions, 107-103 Application for Exemption).** Tyacke, M.J.; Macdonald, R.J. USDOE Idaho Operations Office, Idaho Falls, ID (United States). Aug 1992. 902p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC07-76ID01570. Order Number DE93001922. Source: OSTI; NTIS; INIS; GPO Dep.

Exemption from specific regulations is being sought for the Transuranic Package Transporter Model I (TRUPACT-I) container. The design has successfully undergone extensive testing of a quarter-scale model and a full-scale prototype of the container. Results from the analysis and testing are in the TRUPACT-1 Safely Analysis Report for Packaging (SARP), GA-Al8695/SAND 87-7104 (TTC0735), April 1987 (see Attachment 1). The container was never certified or used because of questions raised during the certification process. Two features of the container design failed to satisfy the regulations for Type B packaging. First, the design utilizes a venting system to control internal and external pressures; this venting system is not allowed by the Code of Federal Regulations, Title 10, Parts 71(h) and 71.51(b) [10 CFR 71.(h) and 71.51(b)]. Second, the maximum quantity fissile material proposed to be hauled in TRUPACT-I exceeded the limits in 10 CFR 71.63(b) for a single-containment container. To correct these design deficiencies, the vents would be plugged during transport, and the maximum quantity of fissile material would be limited to the allowables for a single-containment container. An engineering analysis showed that the container could safely transport radioactive material within the boundaries of the Idaho National Engineering Laboratory (INEL) with the vent system plugged (see Attachment 2). However, some of the requirements for determining pressure on a container need to be changed (i.e., exempted) to reflect conditions unique to the INEL. The following are the requirements needing to be changed for INEL conditions, variances being sought, and justifications for the variances.

2699 (DOE/RW–0374P) **Strategy for OCRWM to provide training assistance to state, tribal, and local governments.** USDOE Office of Civilian Radioactive Waste Management, Washington, DC (United States). Nov 1992. 30p. Sponsored by USDOE, Washington, DC (United States). Source: INIS; OSTI (Free of Charge).

The US Department of Energy's (DOE) Office of Civilian Radioactive Waste Management (OCRWM) has prepared this strategy to outline the process OCRWM will follow to provide funding and technical assistance to States and Indian Tribes as required by Section 180(c) of the Nuclear Waste Policy Act of 1982, as amended (NWPA). A schedule for the various steps to be taken is included. The NWPA directs DOE to dispose of the spent nuclear fuel generated by commercial nuclear power facilities and high-level radioactive waste from defense facilities. OCRWM was established to carry out this mission. OCRWM is developing a transportation system to support shipping of spent nuclear fuel to a Monitored Retrievable Storage (MRS) facility, and spent nuclear fuel and high-level radioactive waste to a final disposal repository. A 1987 amendment to the NWPA added Section 180(c) which states that DOE:. . . shall provide technical assistance and funds to States for training for public safety officials of appropriate units of local government and Indian Tribes through whose jurisdiction the Secretary [of Energy] plans to transport spent nuclear fuel or high-level radioactive waste .... Training shall cover procedures required for safe routine transportation of these materials, as well as procedures for dealing with emergency response situations. This strategy represents a five-step process to meet the requirements of Section 180(c).

2700 (HW–19417) **Procedure for handling uranium in 108-B.** Matheson, A.R. Hanford Works, Richland, WA (United States). 9 Nov 1950. 2p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE93002064. Source: OSTI; NTIS (US Sales Only); GPO Dep.

This memorandum provides procedures to be followed in handling uranium in 108-B.

2701 (HW–76109) **The consequences of accidental releases during rail shipments of radioactive strontium.** Watson, E.C.; Junkins, R.L.; Fuquay, J.J.; Zahn, L.L. General Electric Co., Richland, WA (United States). Hanford Atomic Products Operation. 4 Jan 1963. 16p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE93002084. Source: OSTI; NTIS (US Sales Only); GPO Dep.

Large quantities of radiostrontium inn the form of strontium carbonate have been shipped from HAPO in the HAPO-II shipping systems. Modifications have recently been completed to equip the two HAPO-I systems for shipments of strontium. This report updates previous hazards evaluations such shipments, to account for the greater strontium inventory of the HAPO-I system.

2702 (IAEA-TECDOC–643(v.5), pp. 95-96) **The UKAEA unirradiated fuel transport containers.** Panter, R. (UKAEA Harwell Lab. (United Kingdom)). International Atomic Energy Agency, Vienna (Austria). Apr 1992. In *Research reactor core conversion guidebook. V. 5: Operations (Appendices L-N).* 153p. Order Number DE93607574. Source: OSTI; NTIS (US Sales Only); INIS.

The UKAEA transport containers for unirradiated MTR fuel elements are briefly described. (author).

2703 (IAEA-TECDOC–643(v.5), pp. 97-98) **Transportation of unirradiated TRIGA-LEU fuel.** International Atomic Energy Agency, Vienna (Austria); General Atomics, San Diego, CA (United States). Apr 1992. In *Research reactor core conversion guidebook. V. 5: Operations (Appendices L-N).* 153p. Order Number DE93607574. Source: OSTI; NTIS (US Sales Only); INIS.

Shipping containers for unirradiated TRIGA-LEU fuel are described. (author).

2704 (IAEA-TECDOC–643(v.5), pp. 99-102) **Remarks on the transportation of spent fuel elements.** Krull, W. (GKSS-Forschungszentrum Geesthacht GmbH, Geesthacht-Tesperhude (Germany)). International Atomic Energy Agency, Vienna (Austria). Apr 1992. In *Research reactor core conversion guidebook. V. 5: Operations (Appendices L-N).* 153p. Order Number DE93607574. Source: OSTI; NTIS (US Sales Only); INIS.

Information and data are provided on several aspects of the transportation of spent fuel elements. These aspects include contract, transportation, reprocessing batch size, and economical considerations. (author).

2705 (IAEA-TECDOC–643(v.5), pp. 93-94) **Transportation of fresh fuel elements for Japanese research reactors.** Kanda, K. (Kyoto Univ., Kumatori, Osaka (Japan). Research Reactor Inst.); Nakagome, Y. International Atomic Energy Agency, Vienna (Austria). Apr 1992. In *Research reactor core conversion guidebook. V. 5: Operations (Appendices L-N).* 153p. Order Number DE93607574. Source: OSTI; NTIS (US Sales Only); INIS.

Administrative procedures in Japan for transportation of fresh fuel elements are described. (author). 1 fig.

2706 (IAEA-TECDOC–643(v.5), pp. 103-105) **Transnuklear spent fuel shipping containers.** International Atomic Energy Agency, Vienna (Austria); Transnuklear GmbH, Hanau (Germany). Apr 1992. In *Research reactor core conversion guidebook. V. 5: Operations (Appendices L-N).* 153p. Order Number DE93607574. Source: OSTI; NTIS (US Sales Only); INIS.

Detailed data are provided on the TN-7, TN-7/2, Goslar, and TN-1 spent fuel shipping containers for MTR-type fuel elements. (author).

2707 (IAEA-TECDOC–643(v.5), pp. 107-111) **UKAEA's 'UNIFETCH' irradiated fuel transport containers.** Panter, R. (UKAEA Harwell Lab. (United Kingdom)). International Atomic Energy Agency, Vienna (Austria). Apr 1992. In *Research reactor core conversion guidebook. V. 5: Operations (Appendices L-N).* 153p. Order Number DE93607574. Source: OSTI; NTIS (US Sales Only); INIS.

The UKAEA "UNIFETCH" containers for transport of irradiated fuel from research reactors are described. (author).

2708 (IAEA-TECDOC–643(v.5), pp. 113-116) **The transport of spent fuel elements of research reactors.** International Atomic Energy Agency, Vienna (Austria); CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Inst. de Recherche Technologique et de Developpement Industriel (IRDI). Apr 1992. In *Research reactor core conversion guidebook. V. 5: Operations (Appendices L-N).* 153p. Order Number DE93607574. Source: OSTI; NTIS (US Sales Only); INIS.

The COGEMA 'IU 04' cask, frequently called the 'Pegase' cask, and some of its available internal containers are briefly described. (author).

2709 (IAEA-TECDOC–643(v.5), pp. 117) **Transportation of irradiated TRIGA-LEU fuel.** International Atomic Energy Agency, Vienna (Austria); General Atomics, San Diego, CA (United States). Apr 1992. In *Research reactor core conversion guidebook. V. 5: Operations (Appendices L-N).* 153p. Order Number DE93607574. Source: OSTI; NTIS (US Sales Only); INIS.

Containers for shipping irradiated TRIGA-LEU fuel in the United States and in Europe are described. (author).

2710 (IAEA-TECDOC–643(v.5), pp. 119-136) **Nuclear criticality assessment of LEU and HEU fuel element storage.** Pond, R.B. (Argonne National Lab., IL (United States)); Matos, J.E. International Atomic Energy Agency, Vienna (Austria). Apr 1992. In *Research reactor core conversion guidebook. V. 5: Operations (Appendices L-N).* 153p. Order Number DE93607574. Source: OSTI; NTIS (US Sales Only); INIS.

Criticality aspects of storing LEU (20%) and HEU (93%) fuel elements have been evaluated as a function of ^{235}U loading, element geometry, and fuel type. Silicide, oxide, and aluminide fuel types have been evaluated ranging in ^{235}U loading from 180 to 620 g per element and from 16 to 23 plates per element. Storage geometry considerations have been evaluated for fuel element separations ranging from closely packed formations to spacings of several centimeters between elements. Data are presented in a form in which interpolations may be made to estimate the eigenvalue of any fuel element storage configuration that is within the range of the data. (author). 7 refs, figs and tabs.

2711 (IAEA-TECDOC–643(v.5), pp. 137-142) **Fresh fuel storage.** Nakagome, Y. (Kyoto Univ., Kumatori, Osaka (Japan). Research Reactor Inst.); Kanda, K.; Shibata, T. International Atomic Energy Agency, Vienna (Austria). Apr 1992. In *Research reactor core conversion guidebook. V. 5: Operations (Appendices L-N).* 153p. Order Number DE93607574. Source: OSTI; NTIS (US Sales Only); INIS.

A criticality analysis on the storage of MTR-type medium-enriched uranium (MEU) fuel elements was performed. It was assumed that the MEU fuel elements were arranged vertically in two rows in a stainless steel box, and that the boxes were placed in parallel infinitely at a certain distance. In both sides of the box, 0.3w/o boron-loaded stainless steel plates were used. Moreover, it was assumed that the inside and outside of the box were filled up with water. K_{eff} was calculated as a function of the distance between the boxes by using ANISN-JR code. The effect of boron on K_{eff} was also examined. A similar analysis on the storage of HEU fuel elements was performed and compared with the results on MEU fuels. (author). 2 refs, 4 figs, 2 tabs.

2712 (IAEA-TECDOC–643(v.5), pp. 143-148) **Spent fuel storage.** Merelle, E.C. (Netherlands Energy Research Foundation (ECN), Petten (Netherlands)); Tas, A. International Atomic Energy Agency, Vienna (Austria). Apr 1992. In *Research reactor core conversion guidebook. V. 5: Operations (Appendices L-N).* 153p. Order Number DE93607574. Source: OSTI; NTIS (US Sales Only); INIS.

A criticality analysis on the storage of highly enriched HFR fuel elements, containing 420 g ^{235}U and 1000 mg ^{10}B in the side plates, was performed. The fuel elements are stored in the pool in specially designed compact racks, consisting of cladded cadmium boxes. For reasons of safety and flexibility the analysis of the (spent) fuel elements was performed for an infinite array of fresh elements with 450 g ^{235}U without ^{10}B in the side plates. In the framework of the safety and licensing guidebook additional calculations were performed for LEU fuel elements, containing 450, 475, 600, 675 and 1000 g ^{235}U respectively and compared with the results of the HEU fuel elements. Also the reactivity effect of the cadmium boxes and the presence of Be elements in the boxes was examined. (author). 3 refs, 5 figs, 1 tab.

2713 (KAERI-NEMAC/RR–32/91) **The development of spent fuel storage process equipment: Process equipment automation development.** Yoon, Wan Ki (Korea Atomic Energy Research Inst., Daeduk (Korea, Republic of)); Kim, Ho Dong; Kim, Ki Joon; Kim, Bum Hoe. Korea Atomic Energy Research Inst., Daeduk (Korea, Republic of). Feb 1992. 80p. (In Korean). Order Number DE93607575. Source: OSTI; NTIS (US Sales Only); INIS.

A nuclear material accounting system were designed to track the transitions of nuclear materials at the spent-fuel technology research facility. It is embedded in a distributed control system real-time structure of the system gives timely on-line accountancy. And performance of AC servo motor with fuzzy logic control and its applicability to spent fuel management were experimentally evaluated. (Author).

2714 (KAERI-NEMAC/RR–33/91) **Development of spent fuel storage process equipment: Development of spent fuel remote handling equipment and maintenance technology.** Lee, Jae Sol (Korea Atomic Energy Research Inst., Daeduk (Korea, Republic of)); Yun, ji Sup; Kweon, Sung Kyu; Jeong, Woo Tae; Park, Byung Suk; Park, Young Soo; Paik, Sung Hoon; Kim, Min Suk. Korea Atomic Energy Research Inst., Daeduk (Korea, Republic of). Feb 1992. 138p. (In Korean). Order Number DE93607576. Source: OSTI; NTIS (US Sales Only); INIS.

The scope of the research and development project covers the development of various remote operation technologies which are important assets for the repairment and maintenance of spent fuel handling facilities as well as the actual handling of spent fuels. As a key technology pertaining to such an objective, an anti-swing overhead crane system is developed. The anti-swing crane system is designed to provide oscillation free transportation of heavy equipments and materials such as spent fuel casks in nuclear facilities, therefore, an increased level of safety may be achieved. Also a teleoperated robotic impact wrench system is developed by adopting multi-sensor integration and suitably designed impact wrench module. The performance of the impact wrench system is tested by opening the spent fuel cask lid. Other related efforts in technological innovations are also made in the development of fuzzy logic controller for a tele-visual surveillance system and the design of a three-dimensional range finder. (Author).

2715 (KAERI-NEMAC/RR–45/91) **Development of cask and transportation system: Study on the cask design, test and transportation system.** Ro, Seong Gy (Korea Atomic Energy Research Inst., Daeduk (Korea, Republic of)); Kang, Hee Dong; Lee, Heung Young; Seo, Ki Suk; Koo, Jung Hoe; Jung, Sung Hwan; Yoon, Jung Hyun; Lee, Ju Chan; Bang, Kyung Sik; Baek, Chang Yeol. Korea Atomic Energy Research Inst., Daeduk (Korea, Republic of). Mar 1992. 228p. (In Korean). Order Number DE93607577. Source: OSTI; NTIS (US Sales Only); INIS.

The major goal of this project is to establish the safe transport system and obtain the necessary data for cask development by during research work for the design and safety test of shipping cask. The analysis technique using computer code for design has been studied in the field of structure, thermal and shielding analysis in this study. And also the test and measurement technology was developed for the measuring system of drop and fire test. It is

expected that research activity ensured in this job will enable us to ultilize the basic data for the cask development. (Author).

2716 (SAND–91-2600C) **RADTRAN 5: A computer code for transportation risk analysis.** Neuhauser, K.S. (Sandia National Labs., Albuquerque, NM (United States)); Kanipe, F.L. Sandia National Labs., Albuquerque, NM (United States). [1991]. 6p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-76DP00789. (TTC–1118;CONF-920905–31: 10. international symposium on the packaging and transportation of radioactive materials: PATRAM '92, Yokohama (Japan), 13-18 Sep 1992). Order Number DE93000711. Source: OSTI; NTIS; INIS; GPO Dep.

RADTRAN 5 is a computer code developed at Sandia National Laboratories (SNL) in Albuquerque, NM, to estimate radiological and nonradiological risks of radioactive materials transportation. RADTRAN 5 is written in ANSI Standard FORTRAN 77 and contains significant advances in the methodology for route-specific analysis first developed by SNL for RADTRAN 4 (Neuhauser and Kanipe, 1992). Like the previous RADTRAN codes, RADTRAN 5 contains two major modules for incident-free and accident risk amlysis, respectively. All commercially important transportation modes may be analyzed with RADTRAN 5: highway by combination truck; highway by light-duty vehicle; rail; barge; ocean-going ship; cargo air; and passenger air.

2717 (SAND–91-2627C) **IAEA regulatory initiatives for the air transport of large quantities of radioactive materials.** Luna, R.E. (Sandia National Labs., Albuquerque, NM (United States)); Wangler, M.W.; Selling, H.A. Sandia National Labs., Albuquerque, NM (United States). [1992]. 7p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-76DP00789. (CONF-920905–24: 10. international symposium on the packaging and transportation of radioactive materials: PATRAM '92, Yokohama (Japan), 13-18 Sep 1992). Order Number DE92041159. Source: OSTI; NTIS; INIS; GPO Dep.

The International Atomic Energy Agency (IAEA) has been laboring since 1988 over a far reaching change to its model regulations (IAEA, 1990) for the transport of radioactive materials (RAM). This change could impact the manner in which certain classes of radioactive materials are shipped by air and change some of the basic tenets of radioactive material transport regulations around the world. This report discusses issues associated with air transport regulations.

2718 (SAND–91-2691C) **Information management and collection for US DOE's packaging and transportation needs in the 90's.** Wheeler, T.A. (Sandia National Labs., Albuquerque, NM (United States)); Luna, R.E.; McClure, J.D.; Quinn, G. Sandia National Labs., Albuquerque, NM (United States). [1991]. 9p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-76DP00789. (TTC–1146;CONF-920905–34: 10. international symposium on the packaging and transportation of radioactive materials: PATRAM '92, Yokohama (Japan), 13-18 Sep 1992). Order Number DE93000760. Source: OSTI; NTIS; GPO Dep.

The Transportation Assessment and Integration (TRAIN) Project (US DOE, 1992) was established to provide a systematic approach to identify the problems and needs that will affect the capability of the United States Department of Energy (US DOE) to provide itself with cost-effective, efficient, and coordinated transportation services during the 1990s. Eight issue areas were identified to be included in the TRAIN Project, with one principal investigator assigned to each. The eight areas are as follows: (1) Packaging and Transportation Needs (PATN) in the 1990s; (2) Institutional and Outreach Programs; (3) Regulatory Impacts on Transportation Management; (4) Traffic and Packaging Operations; (5) Research and Development Requirements; (6) Training Support; (7) Emergency Preparedness Requirements; and (8) US DOE-EM 561 Roles and Responsibilities. This paper focuses on the results of the PATN activity of TRAIN. The objective of PATN is to prepare the US DOE, in general, and US DOE-EM 561 (Environmental Restoration and Waste Management (EM), Office of Technology Development, Transportation) in particular, respond to the transportation needs of program elements in the Department. One of the first tasks in evaluating these needs was to formulate the potential for transportation of radioactive materials in the next decade.

0510 Economic, Industrial, and Business Aspects

Refer also to citation(s) 2596, 2731, 2739, 2741, 3037

2719 (DOE/EIA–0478(91)) **Uranium industry annual, 1991.** USDOE Energy Information Administration, Washington, DC (United States). Office of Coal, Nuclear, Electric and Alternate Fuels. Oct 1992. 143p. Sponsored by USDOE, Washington, DC (United States). Order Number DE93001934. Source: OSTI; NTIS; INIS; GPO; GPO Dep.

In the Uranium Industry Annual 1991, data on uranium raw materials activities including exploration activities and expenditures, resources and reserves, mine production of uranium, production of uranium concentrate, and industry employment are presented in Chapter 1. Data on uranium marketing activities including domestic uranium purchases, commitments by utilities, procurement arrangements, uranium imports under purchase contracts and exports, deliveries to enrichment suppliers, inventories, secondary market activities, utility market requirements, and uranium for sale by domestic suppliers are presented in Chapter 2. A feature article entitled "The Uranium Industry of the Commonwealth of Independent States" is included in this report.

2720 (IAEA-TECDOC–650) **New developments in uranium exploration, resources, production and demand: Proceedings of a technical committee meeting held in Vienna, 26-29 August 1991.** International Atomic Energy Agency, Vienna (Austria); Nuclear Energy Agency, 75 - Paris (France). Jun 1992. 258p. (CONF-9108224–: Technical committee meeting on new developments in uranium exploration, resources, production and demand, Vienna (Austria), 26-29 Aug 1991). Order Number DE93607128. Source: OSTI; NTIS (US Sales Only); INIS.

In view of the economic importance, the International Atomic Energy Agency and the Nuclear Energy Agency of the OECD have had a long standing interest in uranium exploration, resources, production and demand. It was the objective of this Technical Committee Meeting to bring together specialists in the field and to collect information on new developments, especially from countries which in the past considered uranium a strategic commodity and the related information as confidential or even secret. Separate abstracts were prepared for each of the 29 papers in this volume. Refs, figs, tabs, charts and maps.

2721 (IAEA-TECDOC–650, pp. 241-248) **Structure of ownership and uranium production, 1970-1990.** Kidd, A.P. (RTZ Limited, London (United Kingdom)). International Atomic Energy Agency, Vienna (Austria); Nuclear Energy Agency, 75 - Paris (France). Jun 1992. (CONF-9108224–: Technical committee meeting on new developments in uranium exploration, resources, production and demand, Vienna (Austria), 26-29 Aug 1991). In *New developments in uranium exploration, resources, production and demand: Proceedings of a technical committee meeting held in Vienna, 26-29 August 1991.* 258p. Order Number DE93607128. Source: OSTI; NTIS (US Sales Only); INIS.

The aim of this paper is to illustrate one aspect of the uranium industry, namely the structure of ownership of production and how this has evolved. The data is based on equity shares on a mine by mine basis. Data for four years has been chosen, spanning a twenty year period from 1970 to 1990. The data are summarised under four categories of ownership, private domestic, Government domestic, private foreign and Government foreign. (author). 3 charts.

2722 (IAEA-TECDOC–650, pp. 248-254) **Taxation impact on uranium mining in Canada and Australia.** Whillans, R.T. (Energy, Mines and Resources Canada, Ottawa, ON (Canada). Electricity Branch). International Atomic Energy Agency, Vienna (Austria); Nuclear Energy Agency, 75 - Paris (France). Jun 1992. (CONF-9108224–: Technical committee meeting on new developments in uranium exploration, resources, production and demand, Vienna (Austria), 26-29 Aug 1991). In *New developments in uranium exploration, resources, production and demand: Proceedings of a technical committee meeting held in Vienna, 26-29 August 1991.* 258p. Order Number DE93607128. Source: OSTI; NTIS (US Sales Only); INIS.

The impact of taxation on the economic viability and competitive position of the uranium industry was studied using four model deposits types as they occur or could occur in different provinces in Australia and Canada. On the basis of project characteristics and assumed uranium prices, before tax indicators such as net revenue, undiscounted cash flow, net present value and rate of return were determined and subjected to the tax regimes in the different jurisdictions using assumed varying levels of cost of capital. Under the assumed conditions, it was found that among the internal factors the uranium prices have a very significant impact on the economics of the model operators. Looking at external factors, the tax systems evaluated in these model operations were found to have a decisive influence on the viability of the operation. Among the fiscal regimes tested, the Saskatchewan royalty system and Australia's Northern Territory tax system generate the highest government revenue but provide the least incentive for investment. However, despite having the highest effective tax rate, the Saskatchewan royalty was found to be attractive at the investment margin and flexible as its progressive nature provides for increasing tax rates as profitability increases. On the contrary, all the other systems are regressive, with relative high tax burdens at the investment margin and decreasing burdens as a function of profitability. (author). 7 tabs.

0520 Waste Management

Refer also to citation(s) 2658, 2659, 2663, 2664, 2666, 2667, 2668, 2671, 2672, 2673, 2674, 2675, 2676, 2677, 2680, 2685, 2693, 2699, 2713, 2714, 2815, 2821, 2828, 2830, 2838, 2839, 2846, 2848, 2852, 2853, 3154, 3156, 3170, 3493, 3602, 3650, 3651, 3769, 3775, 3806, 3911, 3930, 3932, 3934, 4036, 4037, 4171, 4184, 4185, 4204, 4205, 4206, 4210, 4219, 4220, 4221, 4222, 4253, 4254, 4255, 4256

2723 (AECS-PR/RSS–43) **Treatment of radioactive wastes.** Othman, Ibrahim (Atomic Energy Commission, Damascus (Syrian Arab Republic)); Kheitou, Mostafa; Ali, A.F. Atomic Energy Commission, Damascus (Syrian Arab Republic). Jul 1992. 30p. (In Arabic). Order Number DE93607951. Source: OSTI; NTIS (US Sales Only); INIS.

This report is a review of some waste management activities including sources, system of collection and treatment of radioactive wastes. The report also includes methods and options used for treatment of liquid and solid radioactive wastes. (author). 26 refs., 5 figs., 6 tabs.

2724 (AERE-CH–9) **Harwell Laboratory radioactive discharges and environmental monitoring: Annual report for 1991.** AEA Technology, Harwell (United Kingdom). Jun 1992. 48p. Order Number DE93607337. Source: OSTI; NTIS (US Sales Only); INIS.

This report provides information on disposal of radioactive waste from Harwell and on associated environmental monitoring for the calendar year 1991. In most instances information has also been provided on measurements made in previous years to show the 1991 results in their historical perspective. The National Radiological Protection Board, (NRPB) currently recommends a primary dose limit for individual members of the public of 1 mSv per year from sources other than natural background radiation. Operations of a single site such as Harwell should give rise to a dose of no more than 0.5 mSv per year. No member of the public is judged to have exceeded this dose as a consequence of discharges made in 1991. Throughout this report, discharge measurements have been assessed against derived limits corresponding to a dose of 0.5 mSv, consistent with NRPB advice. During the year, work was completed on the revision of both the atmospheric and liquid discharge authorisations, bringing to a close a long period of discussions between the Laboratory and the Authorising Departments (HMIP and MAFF). Draft certificates of authorisation were sent out to local public bodies for consultation in the autumn and the final certificates were in place ready for implementation on the 1st January 1992. Further details are given in the body of this report. (author).

2725 (BfS-ET–10/91-REV-1) **Waste repository conditions and product control.** Brennecke, P.; Martens, B.R. (eds.). Bundesamt fuer Strahlenschutz, Braunschweig (Germany). Fachbereich Nukleare Entsorgung und Transport. Jun 1992. 111p. (In German). Order Number DE93728837. Source: OSTI; NTIS (US Sales Only); INIS.

Before delivering waste forms to the Konrad ore mine, the observance of the (preliminary) waste repository conditions has to be proved in the course of product control. Compliance with waste repository conditions is controlled by the BfS (Federal Office for Radiation Protection), irrespective of waste producers/conditioners, by examining waste forms (documentation and spot checks), qualifying conditioning procedures, determining inspection measures, and checking operational documentation. The measures taken in the course of product control are suitably grouped according to the repository relevant properties of radioactive wastes which are to be checked. Such properties are specified and quantified either directly by the waste repository conditions or by the characteristics derived from waste repository conditions. In the course of procedural qualification, the operational conditions of the conditioning plant are established in such a way as to ensure an appropriate control of repository relevant properties in keeping with the requirements of the repository. The checking of documentaion in the course of inspections, furnished by those who are subject to delivery of wastes, may be supplemented by measurements or viewing. (orig.).

2726 (BfS-ET–10/91-REV-1, pp. 7-48) **Structure of preliminary repository conditions.** Brennecke, P. Bundesamt fuer Strahlenschutz, Braunschweig (Germany). Fachbereich Nukleare Entsorgung und Transport. Jun 1992. (In German). In *Waste repository conditions and product control.* 111p. Order Number DE93728837. Source: OSTI; NTIS (US Sales Only); INIS.

The radioactive wastes with negligible heat development to be stored in the planned Konrad repository come, in particular, from the decommissioning and dismantling of nuclear installations, and from the German Federal Armed Froces and pharmaceutical industry areas. Their disposability was tested by safety analysis studies. The results of those studies have been translated into the requirements specified for disposable waste forms, and they constitute an essential part of the preliminary repository conditions. The structure of those preliminary repository conditions, as amended and revised in July 1991, is outlined and explained. Moreover, the connection between the preliminary repository conditions and the requirements from safety analysis tests is made clear. (orig.).

2727 (BfS-ET–10/91-REV-1, pp. 49-75) **Product control of radioactive wastes.** Martens, B.R. Bundesamt fuer Strahlenschutz, Braunschweig (Germany). Fachbereich Nukleare Entsorgung und Transport. Jun 1992. (In German). In *Waste repository conditions and product control.* 111p. Order Number DE93728837. Source: OSTI; NTIS (US Sales Only); INIS.

The proof of compliance with repository conditions requires organizational and administrative regulations defining the areas of responsibility, tasks and activities of the persons involved. The responsibility of the BfS (Federal Office for Radiation Protection) for performing product control results from its competence, according to paragraph 23 of the Atomic Energy Act, for the operation of federal facilities intended for radioactive waste disposal. The measures envisaged for product control are explained by the BfS under the plan approval procedure for the Konrad repository which is necessary according to paragraph 9 of the Atomic Energy Act, to the Lower Saxony Environment Minister and established by the latter in the plan approval decision, imposing, if appropriate, substantial restrictions or directions. The above regulations are specified in detail. (orig.).

2728 (BfS-ET–10/91-REV-1, pp. 77-103) **Determination of data to prove the observance of repository conditions (parameters and testing criteria of product control).** Martens, B.R. Bundesamt fuer Strahlenschutz, Braunschweig (Germany). Fachbereich Nukleare Entsorgung und Transport. Jun 1992. (In German). In *Waste repository conditions and product control.* 111p. Order Number DE93728837. Source: OSTI; NTIS (US Sales Only); INIS.

Below the fundamental ideas for determining data to prove the disposability of wastes conditioned by those who are subject to delivery, which have been developed by the BfS (Federal Office for Radiation Protection) in the course of the plan assessment procedure for the Konrad repository, are outlined. A uniform approach to the determination and documentation of the necessary data is encouraged. In special cases, however, it may be essential or useful to determine additional or divergent data because of different circumstances or peripheral conditions. Furthermore, it is pointed out that in order to prove the disposability of conditioned wastes, other process engineering circumstances and parameters, such as the technical process of conditioning or measures taken during faulty operations or disturbances, have to be taken into account as well. The statements are restricted to the determination of waste data relevant to final disposal. (orig.).

2729 (CONF-9109358–, pp. 8) **Pollution prevention measures implemented at the Lawrence Livermore National Laboratory's Site 300 facility.** Gonzalez, M.A. (University of California, Livermore (United States)). USDOE, Washington, DC (United States). [1991]. From 8. international conference on chemistry for protection of the environment; Lublin (Poland); 16-18 Sep 1991. In *Chemistry for protection of the environment, Eight international conference: Proceedings.* 635p. Order Number DE92014317. Source: OSTI; NTIS; INIS.

The following major program and support operations are conducted at Site 300: (1) High Explosives Chemistry: Batches of new explosives are processed and formulated for use in high explosives studies; (2) High Explosives Processing: High explosions used in experiments are pressed, machined, and assembled or disassembled; (3) High Explosives Testing: Non-nuclear weapons components and materials are detonated to verify weapons design and material performance; (4) Thermal and Dynamic Weapons Testing: Test units are subjected to thermal and/or dynamic environments that simulate the stockpile-to-target sequence expected in deployed weapons systems; (5) High Energy Physics Research: Development work on future energy power sources is being conducted; (6) Environmental Restoration: Site 300 has been listed as a CERCLA National Priorities List (NPL) site. Extensive soil and groundwater investigations and remediation activities are being conducted; and (7) Institutional Services: Institutional operations, such as maintenance and crafts support, engineering support, medical services, and vehicle maintenance and repair services are provided at Site 300. All of the operations described above generate hazardous waste, ranging from familiar forms such as waste oil from the vehicle maintenance operation to high explosives waste form the High Explosions Chemistry and Processing areas. In addition to hazardous waste, low-level radioactive waste and occasionally mixed (radioactive and hazardous) waste, is generated at the High Explosives Testing facilities. In order to eliminate or minimize waste and pollutant discharges from these Site 300 operations, a Waste Minimization/Pollution Prevention Program was established.

2730 (DOE/EA–0499) **Retrieval and re-storage of transuranic storage area waste at the Idaho National Engineering Laboratory: Environmental assessment.** USDOE Office of Environmental Restoration and Waste Management, Washington, DC (United States). May 1992. 49p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC07-76ID01570. Order Number DE93001936. Source: OSTI; NTIS; INIS; GPO Dep.

The US Department of Energy (DOE) has prepared this environmental assessment (EA) to identify and evaluate the environmental consequences of retrieving and re-storing waste at the Transuranic Storage Area (TSA) within the Radioactive Waste Management Complex (RWMC) at the Idaho National Engineering Laboratory (INEL). Approximately 95% of the TSA waste is contaminated with chemically hazardous/toxic constituents and is termed "mixed" waste. It is conservatively estimated, based on previous waste retrieval and container deterioration studies, that up to 10% of the waste containers may be breached. Approximately 43% of the 65,000 M^3 of TSA waste is expected to be reclassified as LLW or mixed LLW. The reclassified LLW and mixed LLW would eventually be disposed of in approved land disposal sites after any necessary treatment is accomplished. The remaining 57% of the TSA waste is expected to remain classified as TRU waste. DOE's strategy for long-term management of CH TRU waste stored at the INEL and other DOE facilities is to eventually transport the waste to DOE's Waste Isolation Pilot Plant, a deep geologic repository near Carlsbad, New Mexico, for final disposal. The proposed action is to retrieve and re-store TSA waste at the INEL's RWMC. The purpose of the proposed action is to: (1) prevent or delay possible deterioration of TSA waste containers to decrease the probability of future environmental contamination; and (2) bring the TSA waste storage facilities into compliance with the Resource Conservation and Recovery Act and the State of Idaho's Hazardous Waste Management Act requirements.

2731 (DOE/EM–0088P) **Summary of expenditures of rebates from the low-level radioactive waste surcharge escrow account for calendar year 1991: Report to Congress in response to Public Law 99-240.** USDOE Office of Environmental Restoration and Waste Management, Washington, DC (United States). Jun 1992. 27p. Sponsored by USDOE, Washington, DC (United States). Order Number DE93003135. Source: OSTI; NTIS; INIS; GPO Dep.

This is the sixth report submitted to Congress under section 5(d)(2)(E)(ii)(II) of the Low-Level Radioactive Waste Policy Act of 1985 (the Act). This section of the Act directs the Department of Energy (DOE) to summarize the annual expenditures of funds disbursed from the DOE surcharge escrow account and to assess compliance of these expenditures with the limitations specified in the Act. In addition to placing limitations on the use of these funds, the Act also requires the nonsited compact regions and nonmember States to provide DOE with an itemized report of their expenditures on December 31 of each year in which funds are expended. Within 6 months after receiving the individual reports, the Act requires the Secretary to furnish Congress with a summary of the reported expenditures and an assessment of compliance with the specified usage limitations. This report fulfills that requirement. DOE disbursed funds totaling $15,037,778.91 to the States and compact regions following the July 1, 1986, January 1, 1988, and January 1, 1990, milestones specified in the Act. Of this amount, $3,517,020.56 was expended during calendar year 1991 and $6,602,546.24 was expended during the prior 5 years. At the end of December 1991, $4,918,212.11 was unexpended. DOE has reviewed each of the reported expenditures and concluded that all reported expenditures comply with the spending limitations stated in section 5(d)(2)(E)(i) of the Act.

2732 (DOE-HMIP-RR–91.008) **Uranium solubility and solubility controls in selected Needle's Eye groundwaters.** Falck, W.E.; Hooker, P.J. British Geological Survey, Keyworth (United Kingdom). Fluid Processes Research Group. 1991. 32p. Sponsored by Department of the Environment, London (United Kingdom). Her Majesty's Inspectorate of Pollution. Contract PECD-7/9/512. (BGS-TR-WE–90/30.). Order Number DE93607958. Source: OSTI; NTIS (US Sales Only); INIS.

The solubility control of uranium in selected groundwater samples from the cliff and sediments at the Needle's Eye natural analogue site is investigated using the speciation code PHREEQE and the CHEMVAL thermodynamic database (release 3). Alkali-earth bearing uranyl carbonate secondary minerals are likely to exert influence on the solubility . Other candidates are UO_2 and arsenates, depending on the prevailing redox conditions. In the absence of literature data, solubility products for important arsenates have been estimated from analogy with other arsenates and phosphates. Phosphates themselves are unlikely to exert control owing to their comparatively high solubilities. The influence of seawater flooding into the sediments is also discussed. The importance of uranyl arsenates in the retardation of uranium in shallow sediments has been demonstrated in theory, but there are some significant gaps in the thermodynamic databases used. (author).

2733 (DOE/NV/10630–38) **A simulation of the transport and fate of radon-220 derived from thorium-232 low-level waste in the near-surface zone of the Radioactive Waste Management Site in Area 5 of the Nevada Test Site.** Lindstrom, F.T.; Cawlfield, D.E.; Donahue, M.E.; Emer, D.F.; Shott, G.J. Reynolds Electrical and Engineering Co., Inc., Las Vegas, NV (United States). Jul 1992. 34p. Sponsored by USDOE, Washington, DC

(United States). DOE Contract AC08-89NV10630. Order Number DE93003305. Source: OSTI; NTIS; INIS; GPO Dep.

US Department of Energy (DOE) Order 5820.2A (DOE, 1988) requires performance assessment of all new and existing low-level radioactive waste (LLW) disposal sites. An integral part of performance assessment is estimating the fluxes of radioactive gases such as radon-220 and radon-222. Mathematical models, which point out data needs and therefore drive site characterization, provide a logical means of performing the required flux estimations. Thorium-232 Waste, consisting largely of thorium hydroxide and thorium oxides, has been approved for disposal in shallow trenches and pits at the LLW Radioactive Waste Management Site in Area 5 of the Nevada Test Site. A sophisticated gas transport model, CASCADR8 (Lindstrom et al., 1992), was used to simulate the transport and fate of radon-220 from its source of origin nine feet below a closure cap of native soil, through the dry alluvial earth, to its point of release to the atmosphere. CASCADR8 is an M-chain gas-phase radionuclide transport and fate model. It has been tailored to the site-specific needs of the dry desert environment of southern Nevada. It is based on the mass balance principle for each radionuclide and uses gas-phase diffusion as well as barometric pressure-induced advection as its main modes of transport.

2734 (DOE/OR/00033--T499) **Expert System analysis of non-fuel assembly hardware and spent fuel disassembly hardware: Its generation and recommended disposal.** Williamson, D.A. Oak Ridge Associated Universities, Inc., TN (United States). 1991. 326p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-76OR00033. Order Number DE93001698. Source: OSTI; NTIS; INIS; GPO Dep.

Thesis submitted by D.A. Williamson to the University of Florida.

Almost all of the effort being expended on radioactive waste disposal in the United States is being focused on the disposal of spent Nuclear Fuel, with little consideration for other areas that will have to be disposed of in the same facilities. one area of radioactive waste that has not been addressed adequately because it is considered a secondary part of the waste issue is the disposal of the various Non-Fuel Bearing Components of the reactor core. These hardware components fall somewhat arbitrarily into two categories: Non-Fuel Assembly (NFA) hardware and Spent Fuel Disassembly (SFD) hardware. This work provides a detailed examination of the generation and disposal of NFA hardware and SFD hardware by the nuclear utilities of the United States as it relates to the Civilian Radioactive Waste Management Program. All available sources of data on NFA and SFD hardware are analyzed with particular emphasis given to the Characteristics Data Base developed by Oak Ridge National Laboratory and the characterization work performed by Pacific Northwest Laboratories and Rochester Gas & Electric. An Expert System developed as a portion of this work is used to assist in the prediction of quantities of NFA hardware and SFD hardware that will be generated by the United States' utilities. Finally, the hardware waste management practices of the United Kingdom, France, Germany, Sweden, and Japan are studied for possible application to the disposal of domestic hardware wastes. As a result of this work, a general classification scheme for NFA and SFD hardware was developed. Only NFA and SFD hardware constructed of zircaloy and experiencing a burnup of less than 70,000 MWD/MTIHM and PWR control rods constructed of stainless steel are considered Low-Level Waste. All other hardware is classified as Greater-ThanClass-C waste.

2735 (DOE/RL--90-03-Rev.1) **304 Concretion Facility Closure Plan: Revision 1.** USDOE Richland Operations Office, WA (United States). Oct 1991. 274p. Sponsored by USDOE, Washington, DC (United States). Order Number DE93002179. Source: OSTI; NTIS; INIS; GPO Dep.

The Hanford Site, located northwest of Richland, Washington, houses reactors, chemical-separation systems, and related facilities used for the production of special nuclear materials. The 300 Area of the Hanford Site contains reactor fuel manufacturing facilities and several research and development laboratories. Recyclable scrap uranium with Zircaloy-2 and copper silicon allo , uranium-titanium alloy, beryllium/Zircaloy-2 alloy, and Zircaloy-2 chips and fines were secured in concrete billets (7.5-gal containers) in the 304 Concretion Facility (304 Facility), located in the 300 Area. The beryllium/Zircaloy-2 alloy and Zircaloy-2 chips and fines are designated as low-level radioactive mixed waste (LLRMW) with the characteristic of ignitability. The concretion process reduced the ignitability of the fines and chips for safe storage and shipment. This process has been discontinued and the 304 Concretion Facility is now undergoing closure as defined in the Resource Conservation and Recovery Act of 1976 (RCRA) and the Washington Administrative Code (WAC) Dangerous Waste Regulations, WAC 173-303-040 (Ecology 1991). This closure plan presents a description of the facility, the history of materials and wastes managed, and the procedures that will be followed to close the 304 Facility. The strategy for closure of the 304 Facility is presented in Section 6.0.

2736 (DOE/RL--90-04-Rev.1) **303-K Radioactive Mixed-Waste Storage Facility closure plan: Revision 1.** USDOE Richland Operations Office, WA (United States). Nov 1991. 270p. Sponsored by USDOE, Washington, DC (United States). Order Number DE93002176. Source: OSTI; NTIS; INIS; GPO Dep.

The Hanford Site, located northwest of Richland, Washington, houses reactors chemical-separation systems, and related facilities used for the production o special nuclear materials. The 300 Area of the Hanford Site contains reactor fuel manufacturing facilities and several research and development laboratories. The 303-K Radioactive Mixed-Waste Storage Facility (303-K Facility) has been used since 1943 to store various radioactive,and dangerous process materials and wastes generated by the fuel manufacturing processes in the 300 Area. The mixed wastes are stored in US Department of Transportation (DOT)-specification containers (DOT 1988). The north end of the building was used for storage of containers of liquid waste and the outside storage areas were used for containers of solid waste. Because only the north end of the building was used, this plan does not include the southern end of the building. This closure plan presents a description of the facility, the history of materials and wastes managed, and a description of the procedures that will be followed to chose the 303-K Facility as a greater than 90-day storage facility. The strategy for closure of the 303-K Facility is presented in Chapter 6.0.

2737 (DOE/RL--91-35) **3718-F Alkali Metal Treatment and Storage Facility Closure Plan.** USDOE Richland Operations Office, WA (United States). Dec 1991. 198p. Sponsored by USDOE, Washington, DC (United States). Order Number DE93002239. Source: OSTI; NTIS; INIS; GPO Dep.

Since 1987, Westinghouse Hanford Company has been a major contractor to the U.S. Department of Energy-Richland Operations Office and has served as co-operator of the 3718-F Alkali Metal Treatment and Storage Facility, the waste management unit addressed in this closure plan. The closure plan consists of a Part A Dangerous waste Permit Application and a RCRA Closure Plan. An explanation of the Part A Revision (Revision 1) submitted with this document is provided at the beginning of the Part A section. The closure plan consists of 9 chapters and 5 appendices. The chapters cover: introduction; facility description; process information; waste characteristics; groundwater; closure strategy and performance standards; closure activities; postclosure; and references.

2738 (DOE/RW--0361-TG) **Science, society, and America's nuclear waste: Unit 1, Nuclear waste: Teacher guide.** USDOE Office of Civilian Radioactive Waste Management, Washington, DC (United States). [1992]. 157p. Sponsored by USDOE, Washington, DC (United States). Source: OSTI (Free of Charge); INIS.

This is unit 1 in a four-unit secondary curriculum. It is intended to provide information about scientific and societal issues related to the management of spent nuclear fuel from generation of electricity at nuclear powerplants and high-level radioactive waste from US national defense activities. The curriculum, supporting classroom activities, and teaching materials present a brief discussion of energy and electricity generation, including that produced at nuclear powerplants; information on sources, amounts, location, and characteristics of spent nuclear fuel and high-level radioactive waste; sources, types and effects of radiation; US policy for managing and disposing of spent nuclear fuel and high-level radioactive waste and what other countries are doing; and the components of the nuclear waste management system.

2739 (DOE/RW–0363-SR) **Science, society, and America's nuclear waste: Unit 3, The Nuclear Waste Policy Act.** USDOE Office of Civilian Radioactive Waste Management, Washington, DC (United States). 1992. 33p. Sponsored by USDOE, Washington, DC (United States). Source: OSTI (Free of Charge); INIS.

This is the 3rd unit, (The Nuclear Waste Policy Act) a four-unit secondary curriculum. It is intended to provide information about scientific and societal issues related to the management of spent nuclear fuel from generation of electricity at nuclear powerplants and high-level radioactive waste from US national defense activities. The curriculum, supporting classroom activities, and teaching materials present a brief discussion of energy and electricity generation, including that produced at nuclear powerplants; information on sources, amounts, location, and characteristics of spent nuclear fuel and high-level radioactive waste; sources, types and effects of radiation; US policy for managing and disposing of spent nuclear fuel and high-level radioactive waste and what other countries are doing; and the components of the nuclear waste management system.

2740 (DOE/RW–0364-SR) **Science, society, and America's nuclear waste: Unit 4, The waste management system.** USDOE Office of Civilian Radioactive Waste Management, Washington, DC (United States). [1992]. 55p. Sponsored by USDOE, Washington, DC (United States). Source: OSTI (Free of Charge); INIS.

This is unit 4 (The Waste Management System) in a four-unit secondary curriculum. It is intended to provide information about scientific and societal issues related to the management of spent nuclear fuel from generation of electricity at nuclear powerplants and high-level radioactive waste from US national defense activities. The curriculum, supporting classroom activities, and teaching materials present a brief discussion of energy and electricity generation, including that produced at nuclear powerplants; information on sources, amounts, location, and characteristics of spent nuclear fuel and high-level radioactive waste; sources, types and effects of radiation; US policy for managing and disposing of spent nuclear fuel and high-level radioactive waste and what other countries are doing; and the components of the nuclear waste management system.

2741 (DOE/RW–0364-TG) **Science, society, and America's nuclear waste: Unit 4, The waste management system: Teacher guide.** USDOE Office of Civilian Radioactive Waste Management, Washington, DC (United States). [1992]. 235p. Sponsored by USDOE, Washington, DC (United States). Source: OSTI (Free of Charge); INIS.

This is the teachers guide to unit 4, (The Waste Management System), of a four-unit secondary curriculum. It is intended to provide information about scientific and societal issues related to the management of spent nuclear fuel from generation of electricity at nuclear powerplants and high-level radioactive waste from US national defense activities. The curriculum, supporting classroom activities, and teaching materials present a brief discussion of energy and electricity generation, including that produced at nuclear powerplants; information on sources, amounts, location, and characteristics of spent nuclear fuel and high-level radioactive waste; sources, types and effects of radiation; US policy for managing and disposing of spent nuclear fuel and high-level radioactive waste and what other countries are doing; and the components of the nuclear waste management system.

2742 (ETDE-IT–92-79) **Dry active waste incineration by electric heating: ENEL pilot plant performance.** Sandrelli, G.; Terrani, S.; Pandolfi, M. Ente Nazionale per l'Energia Elettrica, Milan (Italy). Centro Termica e Nucleare; Politecnico di Milano, Milan (Italy). Ist. di Ingegneria Nucleare. Feb 1992. 26p. (In Italian). (CONF-9202139–1: Rifiuti urbani ed industriali, Milan (Italy), 10-12 Feb 1992). Order Number DE93729471. Source: OSTI; NTIS (US Sales Only); INIS.

ENEL (Italian Electricity Board)/DSR carried out an experimental research aimed at exploring the possibilities offered by an advanced electric incineration technique as a solution for the disposal of organic, low-level radioactive wastes discharged from nuclear power plants. A demonstrative l-kg/h throughput incineration plant was built on which several testing campaigns were performed by burning either radioactive wastes with high sulphur content, but chlorine-free, or radioactive wastes containing significant amounts of both sulphur and chlorine. All tests showed that the proposed process can burn the waste completely, achieving the theoretical mass reduction factors depending only on the inorganic initial loading of the waste. At the same time it was possible to verify that the emissions of chemical and radioactive pollutants are extremely low and in any case in accordance with the acceptability limits enforced by Italian laws. Owing to the good experimental results, some possible strategies for the use of the process already set up have been studied.

2743 (GSF–31/91) **Recent state report: Groundwater programmes of variable density. Study performed within the framework of a programme for safety of contaminated waste repositories in the post-operational phase.** Fein, E. (GSF, Inst. fuer Tieflagerung, Abt. fuer Endlagersicherheit, Braunschweig (Germany)). GSF - Forschungszentrum fuer Umwelt und Gesundheit GmbH, Neuherberg (Germany); Bundesministerium fuer Forschung und Technologie, Bonn (Germany). Dec 1991. 61p. (In German). Contract BMFT KWA 5901. (GSF-TL–23/91). Order Number DE93728687. Source: OSTI; NTIS (US Sales Only); INIS.

This report summarises basic facts and data that may be helpful in decisions about the development of a groundwater programme for the calculation of saline groundwater movements. Generally accepted requirements of a rapid groundwater programme for the assessment of flow mechanisms above salt domes are defined. It also describes the possibilities offered by similar programmes already in progress on a national and international basis and discusses state-of-the-art numerical methods and hardware in respect of speed and efficiency of the relevant computer programmes. The availability of a rapid groundwater programme would make it possible for model calculations in connection with long-term safety analyses to take account of the influence of salinity on groundwater movements in extended and complex model regions. (orig./DG).

2744 (GSF–39/91) **State of the art in establishing computed models of adsorption processes to serve as a basis of radionuclide migration assessment for safety analyses. Status report.** Koss, V. (GSF - Forschungszentrum fuer Umwelt und Gesundheit GmbH, Inst. fuer Tieflagerung, Braunschweig (Germany)). GSF - Forschungszentrum fuer Umwelt und Gesundheit GmbH, Neuherberg (Germany); Bundesministerium fuer Forschung und Technologie, Bonn (Germany). 1991. 56p. (In German). Contract BMFT KWA 5901. (GSF-TL–34/91). Order Number DE93728728. Source: OSTI; NTIS (US Sales Only); INIS.

An important point in safety analysis of an underground repository is adsorption of radionuclides in the overlying cover. Adsorption may be judged according to experimental results or to model calculations. Because of the reliability aspired in safety analyses, it is necessary to strengthen experimental results by theoretical calculations. At the time, there is no single thermodynamic model of adsorption to be agreed on. Therefore, this work reviews existing equilibrium models of adsorption. Limitations of the K_d-concept and of adsorption-isotherms according to Freundlich and Langmuir are mentioned. The surface ionisation and complexation edl model is explained in full as is the criticism of this model. The application is stressed of simple surface complexation models to adsorption experiments in natural systems as is experimental and modelling work according to systems from Gorleben. Hints are given how to deal with modelling of adsorption related to Gorleben systems in the future. (orig.).

2745 (KAERI-NEMAC/RR–34/91) **Basic chemistry for radioactive waste management: Studies on the chemical behaviors of radioactive elements.** Eom, Tae Yoon (Korea Atomic Energy Research Inst., Daeduk (Korea, Republic of)); Park, Kyeong Kyun; Kim, Won Ho; Jee, Kwang Yong; Kim, Jong Koo; Park, Young Jae; Yoo, Man Soo; Jee, Chun Suk; Song, Byung Chul; Choi, Kyae Chun. Korea Atomic Energy Research Inst., Daeduk (Korea, Republic of). Mar 1992. 143p. (In Korean). Order Number DE93607944. Source: OSTI; NTIS (US Sales Only); INIS.

The goal of this study is to obtain the information about the chemical behavior of radionuclides in groundwater for the safety of radioactive waste management. The effect of o-phenanthroline and 2,2'-bipyridine on the adsorption of metal(II) (Mn, Fe, Co, Ni, and

Cu) to silica gel surface, computer program for calculation of compound concentrations in multi-composition system, Np-237 reagent purification by anion exchange resin, characterization of installed basic photoacoustic spectrophotometer, and study of pH, ionic strength and metal ion adsorption on humic acid size distribution were described. (Author).

2746 (KAERI-NEMAC/RR–35/91) **A study on the safety of spent fuel management: A scenario study on spent fuel management.** Chun, Kwan Sik (Korea Atomic Energy Research Inst., Daeduk (Korea, Republic of)); Park, Hyun Soo; Ahn, Jin Soo; Hwang, Joo Ho; Choi, Jong Won; Kim, Yeon Soo; Park, Ju Hwan; Chung, Choong Hwan. Korea Atomic Energy Research Inst., Daeduk (Korea, Republic of). Mar 1992. 194p. (In Korean). Order Number DE93607945. Source: OSTI; NTIS (US Sales Only); INIS.

In order to produce data applicable for the long-term policy making of spent fuel management and to suggest a basic scenario suitable to domestic situation, the pre-conceptual design of reference disposal facilities for the spent fuel and the vitrified high level radioactive waste from its reprocessing, has been performed. From the results of the pre-conceptual study, further research and development areas to accumulate the disposal technology are suggested. In addition, the physico-chemical properties and functional characteristics of domestic bentonite are analyzed to assess its applicability as a buffer material which would play a major role for the safe disposal of highly active waste including spent fuels. (Author).

2747 (KAERI-NEMAC/RR–36/91) **Basic chemistry for radioactive waste management: Study on the corrosion of materials for radwaste containment.** Choi, In Kyu (Korea Atomic Energy Research Inst., Daeduk (Korea, Republic of)); Jung, Ki Suk; Ha, Yeong Keong; Yeon, Jei Won. Korea Atomic Energy Research Inst., Daeduk (Korea, Republic of). Mar 1992. 57p. (In Korean). Order Number DE93607946. Source: OSTI; NTIS (US Sales Only); INIS.

To study the mechanism of the corrosion process of the related materials and to control corrosion process in relation to the nuclear radwaste management, corrosion behavior of iron and carbon steel in groundwater was studied. Effect of bicarbonate ion, which is one of the most abundant species in groundwater, was studied under both air and nitrogen atmosphere. Bicarbonate ion affects the passivation on the surface of iron and carbon steel. Passive films formed on the carbon steel is more stable than that on pure iron. In groundwater, in which very low concentration of bicarbonate ion is contained, passivation does not occur but pitting corrosion was resulted. Inconel 600 and pure Ni were also tested to elucidate the corrosion mechanism. While Inconel 600 and Ni did not involve hydrogen or hydroxide ions during oxidation process, corrosion process of carbon steel involved either hydrogen or hydroxide ions. (Author).

2748 (KAERI-NEMAC/RR–37/91) **Development of the safety assessment technology for the radioactive waste disposal: Analyses of container corrosion and radionuclide release.** Kim, Chang Lak (Korea Atomic Energy Research Inst., Daeduk (Korea, Republic of)); Choi, Kwang Sub; Cho, Chan Hee; Lee, Myung Chan; Kim, Jhin Wung. Korea Atomic Energy Research Inst., Daeduk (Korea, Republic of). Mar 1992. 103p. (In Korean). Order Number DE93607960. Source: OSTI; NTIS (US Sales Only); INIS.

The major goal of this project is to develop a source-term model for the safety assessment of a low- and intermediate-level radioactive waste repository as follows: (1) estimation of the arising of low- and intermediate-level radioactive wastes, (2) development of inventory data base, (3) development of a source-term code for shallow-land disposal, and (4) improvement of the REPS source-term code for rock cavern type disposal developed already in 1990 and conservative safety assessment for an imaginary repository. In addition, the source of C-14 in the inventory is assessed by two methods: decontamination factor and scaling factor. The source-term code for shallow-land disposal include the following submodels: surface water penetration into the repository, concrete degradation, corrosion of container drums, leaching of radionuclides from waste forms, and migration of radionuclides from engineered disposal facility is estimated by this code. (Author).

2749 (KAERI-NEMAC/RR–42/91) **A study on the safety of spent fuel management: Radioactive source term modelling.** Chun, Kwan Sik (Korea Atomic Energy Research Inst., Daeduk (Korea, Republic of)); Lee, Hoo Keun; Park, Keun Il; Hwoang, Jung Ki; Chung, Choong Hwan. Korea Atomic Energy Research Inst., Daeduk (Korea, Republic of). Feb 1992. 179p. (In Korean). Order Number DE93607947. Source: OSTI; NTIS (US Sales Only); INIS.

The types and probabilities of events which may occur during the process of reception, transfer and storage of spent fuels in an away-from-reactor (AFR) spent fuel storage facility were analyzed in order to calculate the amount of radioactive material released to operation area and atmosphere, and the basic model for predicting the radioactive source-term under normal and abnormal operations were developed. Also, oxidation and dissolution of UO_2 pellet was investigated to estimate the amount of radioactive materials released from spent fuel and the release characteristics of radionuclides from defected spent fuel rods was analyzed. Basic information using FIRAC code to analyze the ventilation system during fire accident was prepared and FIRIN was detached from FIRAC modified to simulate the compartment fire by personal computer. (Author).

2750 (KAERI-NEMAC/RR–43/91) **Evaluation of structural behavior, geological and hydrogeological characteristics: A study on the structural behavior of underground openings considering the effect of excavation.** Kim, Jhin Wung (Korea Atomic Energy Research Inst., Daeduk (Korea, Republic of)); Kim, Sun Hoon; Kim, Dae Hong; Choi, Kyu Sup. Korea Atomic Energy Research Inst., Daeduk (Korea, Republic of). Feb 1992. 208p. (In Korean). Order Number DE93607961. Source: OSTI; NTIS (US Sales Only); INIS.

In order to understand the behavior of an underground structure properly, this report includes the study on the structural behavior of rock masses surrounding underground openings considering the effect of excavation. Before analyzing the underground structure, the followings are studied: initial stress distribution before excavation, stress release and redistribution due to the sequential excavation, comparison of analysis methods, discussions on numerical simulation techniques for the sequential excavation and an numerical analysis modeling. The underground structure in then analyzed using the finite element and distinct element methods of analysis considering the effect of sequential excavation, Based on the results of the analysis, the followings are discussed: shape of the opening, distance between openings, method and sequence of excavation, and structural reinforcement. (Author).

2751 (KAERI-NEMAC/RR–46/91) **The development of waste form characterization technology.** Park, Hun Whee (Korea Atomic Energy Research Inst., Daeduk (Korea, Republic of)); Lee, Byung Jik; Lee, Kang Moo; Jung, In Ha; Lee, Jae Won; Bae, Sang Min; Kim, Ki Hong. Korea Atomic Energy Research Inst., Daeduk (Korea, Republic of). Mar 1992. 220p. (In Korean). Order Number DE93607948. Source: OSTI; NTIS (US Sales Only); INIS.

Through this project, we developed the method of making proper specimens in order to examine the charateristics of the waste form and performed some physical tests of waste form such as compressive strength measurement, leaching test, and free liquid detection with prepared specimen. Also we made the waste form test procedure about fire resistance, gas permeability, weather resistance, free liquid detection method and so on. Furthermore, the performance test procedure being taken by KINS for Solid Waste Form Facility was described. (Author).

2752 (KAERI-NEMAC/RR–47/91) **A safety study on spent fuel management: A study on the behavior of a spent fuel storage structure subject to heavy dropped impact loads.** Seo, Jeong Moon (Korea Atomic Energy Research Inst., Daeduk (Korea, Republic of)); Kim, Jae Kwan; Choun, Young Sun; Lee, Kyung Jin; Choi, In Kil. Korea Atomic Energy Research Inst., Daeduk (Korea, Republic of). Mar 1992. 168p. (In Korean). Order Number DE93607962. Source: OSTI; NTIS (US Sales Only); INIS.

Fundamental mechanism of impact phenomena and methods of analysis for impact loads are critically reviewed. A methodology and procedure on the analysis for the impact loads in a canister storage pool are established. The structural and functional integrity of the storage pool(conceptual design) subject to heavy dropped

impact loads are analyzed by analytical and numerical method. Based on the results specific recommendations are made for the future design of a pool structure. (Author).

2753 (KAERI-NEMAC/RR–49/91) **Development of the safety assessment technology for the radwaste disposal.** Han, Kyung Won (Korea Atomic Energy Research Inst., Daeduk (Korea, Republic of)); Cho, Won Jin; Lee, Jae Owan; Lee, Myun Joo. Korea Atomic Energy Research Inst., Daeduk (Korea, Republic of). Mar 1992. 105p. (In Korean). Order Number DE93607963. Source: OSTI; NTIS (US Sales Only); INIS.

This study intended to obtain the basic data for selection of optimum backfill material and to develop radionuclide release model. To determine the equilibrium nuclide concentrations in the waste repository, the chemical conditions in the waste form/container/groundwater system were investigated assuming that the domestic cemented waste forms containing evaporator concentrate were packed into carbon steel containers and disposed into repository. Then the equilibrium concentration of Co-60 was studied. The influence of moisture content of clay and compacting pressure on the clay bulk density was investigated, and the changes of water permeability as a function of clay bulk density were measured. The diffusion coefficient of cesium and iodide in dense clay were measured using the through diffusion and the in diffusion experimental techniques to investigate the influence of measuring methods and initial concentration on the values of diffusion coefficients. For the validation of radionuclide release model, RTBIF, the experimental apparatus simulating near-field in repository was made and experiments using low and high density bentonites were conducted. (Author).

2754 (KAERI-NEMAC/RR–50/91) **The development of radioactive waste treatment technology(IV): A study on the hot off-gas treatment process.** Kim, Joon Hyung (Korea Atomic Energy Research Inst., Daeduk (Korea, Republic of)); Ahan, Byung Gil; Kim, Jeong Guk; Yim, Sung Paal. Korea Atomic Energy Research Inst., Daeduk (Korea, Republic of). Mar 1992. 98p. (In Korean). Order Number DE93607952. Source: OSTI; NTIS (US Sales Only); INIS.

A full-scale silicon carbide filter (flanged candle type) was made by using an oxide ceramic binder. From the results of filtration test, the manufactured SiC filter was comparable to foreign commercial filters. But the composite type filter with a thin fiber layer on its surface showed more excellent filtration performance than granular bed filter. It is expected that large hysterisis of sintering binder on heating and cooling process would cause a problem in high temperature application. From the results, the development of composite type filter and a study on sintering binder must be continued. Such study results could be utilized for the off-gas treatment of radioactive waste treatment process and general industry. And it will be used as a basic data for solid/gas separation process. (Author).

2755 (KAERI-NEMAC/RR–51/91) **A study on the safety of spent fuel management: A study on the radioactive gas treatment system.** Park, Seong Won (Korea Atomic Energy Research Inst., Daeduk (Korea, Republic of)); Chun, Kwan Sik; Lee, Hoo Kuen; Park, Kuen Il; Jung, Myung Soo; Kim, You Sun. Korea Atomic Energy Research Inst., Daeduk (Korea, Republic of). Mar 1992. 105p. (In Korean). Order Number DE93607953. Source: OSTI; NTIS (US Sales Only); INIS.

In order to establish the effective removal system of radioactive iodine compound generated from the nuclear facilities, study on adsorption and desorption of organic iodine by impregnated active carbon was carried out. Physical characteristics of impregnated active carbon was identified, and the adsorption of water vapor and the methyl iodide adsorption and desorption characteristics by impregnated active carbon were studied. Also, the weathering effects on impregnated active carbon was analyzed to evaluate the long-term capacity of impregnated active carbon. In addition, the existing test facility of impregnated active carbon was partly updated by incorporating sophisticated temperature and humidity controling system. (Author).

2756 (KAERI-NEMAC/RR–52/91) **The development of radioactive waste treatment technology(IV): The development of radioactive waste treatment technology(II).** Kim, Joon Hyung (Korea Atomic Energy Research Inst., Daeduk (Korea, Republic of)); Yim, Sung Paal; Lee, Kune Woo; Yoo, Jeong Woo; Kim, Young Min; Park, Seong Chul. Korea Atomic Energy Research Inst., Daeduk (Korea, Republic of). Mar 1992. 275p. (In Korean). Order Number DE93607954. Source: OSTI; NTIS (US Sales Only); INIS.

Following studies were performed in the project of development of radioactive waste treatment technology. (1) Treatment of radioactive borated liquid wastes by reverse osmosis : Separation characteristics of boric acid were estimated using cellulose acetate membrane and aromatic polyamide membrane. The performance of reverse osmosis process was evaluated in terms of boric acid recovery, radiochemical rejection, and membrane flux by operating variables such as applied pressure and feed concentration. (2) Oily waste treatment : The mathematical model to estimate oil removal efficiency is to be proposed at coalescence column. (3) Treatment of radioactive laundry waste (4) Comparison of evaporation and ion-exchange (5) State of the art of high integrity container. (Author).

2757 (KAERI-NEMAC/RR–53/91) **Development of the safety assessment technology for the radwaste disposal: Development of the safety assessment computer code for the radwaste disposal.** Kang, Chul Hyung (Korea Atomic Energy Research Inst., Daeduk (Korea, Republic of)); Lee, Youn Myung; Park, Hee Sung; Seo, Kyung Suk. Korea Atomic Energy Research Inst., Daeduk (Korea, Republic of). Feb 1992. 85p. (In Korean). Order Number DE93607964. Source: OSTI; NTIS (US Sales Only); INIS.

In this study development of safety assessment code for shallow land disposal system and analyses of the scenarios for safety assessment have been carried out. For radionuclide migration model for shallow land disposal, a 2-D model has been set up and analytical solution has been developed. Also FEMWASTE code has been selected as a numerical solution and has been set up for KAERI computer system. Three different scenarios have been adopted for dose model, i.e., groundwater scenario, well scenario, and intruder scenario. To examine usability of the model, the safety assessment of hypothetical reference shallow land repository has been performed. The results showed that the role of the backfill was very critical in shallow land disposal system, and intruder scenario was the most critical path. To develop the scenario for performance assessment, several potential processes and event have been studied, and selected for further study to select scenario to fit Korean environment. (Author).

2758 (KAERI-NEMAC/RR–54/91) **The development of radioactive waste treatment technology(IV): The development of solidification technology.** Kim, Hwan Young (Korea Atomic Energy Research Inst., Daeduk (Korea, Republic of)); Kim, Ki Hong; Kang, Mun Ja; Lee, Jae Won. Korea Atomic Energy Research Inst., Daeduk (Korea, Republic of). Mar 1992. 81p. (In Korean). Order Number DE93607955. Source: OSTI; NTIS (US Sales Only); INIS.

The installation of straight unit and evaporator, the improvement of mixing blade could be reduced a drying time and had no trouble in maintaining a drying process of borate waste. In plastic solidification of powdered cation exchange resins, a sound waste forms was obtained above 33.2 wt% of their water content. And according to the increase of their water content, the compressive strength of waste forms was decreased. The degradation rate of spent cation exchange resins by using Fenton's reagent was 87.6% in reaction condition of resin/hydrogen peroxide = 0.095, 0.065 M Fe^{+2}. And the study on wet oxidation of anion exchange resins is needed for treatment of mixed resins furthermore. The ratio of unsaturated polyester/cement in a composite waste forms was about 0.075 for a good workability, curing time and mechanical properties. (Author).

2759 (KAERI-NEMAC/RR–56/91) **Development of the safety assessment technology for the radwaste disposal: A study on the migration of radionuclides in the repository.** Han, Kyong Won (Korea Atomic Energy Research Inst., Daeduk (Korea, Republic of)); Park, Sang Won; Park, Jung Kyun; Cho, Young Hwan. Korea Atomic Energy Research Inst., Daeduk (Korea, Republic of). Feb 1992. 123p. (In Korean). Order Number DE93607965. Source: OSTI; NTIS (US Sales Only); INIS.

Experiments and the model construct of the sorptive and/or diffusive behavior of the radionuclides were conducted to elucidate the migration phenomena of the radionuclides in the subsurface environments, and to provide the input data for the safety assessment

of the nuclearwaste disposal. Sorption characteristics of the uranium and iodine onto the granite, tuff, and some clays were studied, and the sorption database was completed under limited but representative geochemical conditions. The surface complexation model (SCM) was studied for the radionuclides partitioning in geochemical settings; as a more conceptually satisfying alternative to the Kd approach which has been exclusively used to estimate radionuclide retardation factors in performance assessment calculations for the repository site. Diffusion experiments of sorptive and nonsorptive nuclides were conducted to determine effective diffusivity, geometric factor, and to propose the diffusion model by the through-diffusion method. (Author).

2760 (K/TCD–1031) **Effluent testing for the Oak Ridge Toxic Substances Control Act mixed waste incinerator, December 11, 1991.** Shor, J.T. (Oak Ridge National Lab., TN (United States)); Bostick, W.D.; Hoffmann, D.P.; Gibson, L.V. Jr.; Ho, T.C. Oak Ridge K-25 Site, TN (United States). Jul 1992. 23p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OT21400. Order Number DE92040513. Source: OSTI; NTIS; GPO Dep.

As part of a quarterly program to assess incinerator performance in vital areas, an emissions test for uranium and particulates was performed at the K-1435 dual-purpose (TSCA/RCRA) incinerator on December 11, 1991. The test lasted 5 h. The Incinerator met Resource Conservation and Recovery Act (RCRA) standards for particulate emissions and experienced uranium stack emissions of 6.11 g/h (or 8% of feed) during a 5-h performance experiment conducted under TSCA conditions on December 11, 1991. Partitioning of uranium to the scrubber purge streams was comparable with past performance. Particulate size distributions in the scrubber purge streams showed finer mean particle diameters, but no statistically significant difference between the purge streams is apparent The relatively high uranium emissions are believed to result from the exceptionally high chlorine content of the feed and the fact that approximately 79% of the uranium was fed to the secondary combustion chamber (SCC) rather than the kiln.

2761 (LA–12414-MS) **Shift-register neutron-coincidence counting and the gray barrel problem.** Brunson, G.S. (Los Alamos National Lab., NM (United States)); Nicholas, N.J. Los Alamos National Lab., NM (United States). Oct 1992. 38p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. Order Number DE93001616. Source: OSTI; NTIS; INIS; GPO Dep.

For purposes of nuclear waste assay, we have developed a shift-register-type neutron-coincidence-counting system and associated software that are capable of estimating the mass of plutonium in a container despite (1) uncertainty as to the fraction of neutrons arising from the (α,n) reaction in light nuclei; and (2) uncertainty, resulting from unknown absorption and/or moderation, as to the actual sensitivity of the counter. However, if the plutonium is in lumps of several grams or more, the neutron multiplication will diminish, but not vitiate, the accuracy of the estimate. We have an algorithm which reliably identifies those cases in which there is significant multiplication and enables us to improve the mass estimate. Our present counting setup is capable of handling containers of only a few cubic feet, but the technique and software are usable with any counter of adequate sensitivity; 20% is adequate but higher sensitivity is better. Our experience also shows it is important that the sensitivity of the counter should be as uniform as possible throughout the counting volume.

2762 (NSS-R–177) **Mineralogy and petrography of Caithness Flagstones used in sorption experiments by Harwell Laboratories.** Bloodworth, A.J. (British Geological Survey, Keyworth (United Kingdom)); Kemp, S.J.; Inglethorpe, S.D.J.; Morgan, D.J. United Kingdom Nirex Ltd., Harwell (United Kingdom). Mar 1989. 43p. Contract UX/96/243. Order Number DE93607967. Source: OSTI; NTIS (US Sales Only); INIS.

The mineralogy and petrography of a suite of samples taken from the Caithness Flagstones are described. Samples were collected from core material obtained from a borehole beneath DNE Dounreay, Highland Region, and are duplicates of those used in sorption experiments by Harwell Laboratories. The geological background of the samples is described, with particular emphasis on the development of lithologically distinct facies within the laminated lacustrine sediments examined in this study. Optical examination reveals distinctive sedimentary structures and petrofabrics associated with different lithofacies. Lithofacies type is also reflected in mineralogical variation within the sequence. Highly-laminated, deeper-water facies rocks are typified by the presence of ferroandolomite cement, with relatively high clay and organic matter contents. Detrital quartz and feldspar are more abundant in the shallow water facies and the carbonate assemblage in these rocks is dominated by calcite. Though total clay content varies with facies, the distribution of clay mineral species remains largely identical. There is a complex pattern of carbonate and pyrite diagenesis within these sediments. (author).

2763 (NSS-R–259) **Validation of transport models for use in repository performance assessments: a view illustrated for INTRAVAL test case 1b.** Jackson, C.P. (British Geological Survey, Keyworth (United Kingdom). Fluid Processes Research Group); Lever, D.A.; Sumner, P.J. AEA Decommissioning and Radwaste, Harwell (United Kingdom). Mar 1991. 38p. Sponsored by United Kingdom Nirex Ltd., Harwell (United Kingdom). (AEA-D and R–0120.). Order Number DE93607968. Source: OSTI; NTIS (US Sales Only); INIS.

We present our views on validation. We consider that validation is slightly different for general models and specific models. We stress the importance of presenting for review the case for (or against) a model. We outline a formal framework for validation, which helps to ensure that all the issues are addressed. Our framework includes calibration, testing predictions, comparison with alternative models, which we consider particularly important, analysis of discrepancies, presentation, consideration of implications and suggested improved experiments. We illustrate the approach by application to an INTRAVAL test case based on laboratory experiments. Three models were considered: a simple model that included the effects of advection, dispersion and equilibrium sorption, a model that also included the effects of rock-matrix diffusion, and a model with kinetic sorption. We show that the model with rock-matrix diffusion is the only one to provide a good description of the data. We stress the implications of extrapolating to larger length and time scales for repository performance assessments. (author).

2764 (ORNL/ER–84) **Risk-based prioritization for the interim remediation of inactive low-level liquid radioactive waste underground storage tanks at Oak Ridge National Laboratory, Oak Ridge, Tennessee.** Chidambariah, V.; Travis, C.C.; Trabalka, J.R.; Thomas, J.K. Oak Ridge National Lab., TN (United States). Environmental Restoration Div. Sep 1992. 29p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. Order Number DE93000553. Source: OSTI; NTIS; INIS; GPO Dep.

The paper presents a risk-based approach for rapid prioritization of low-level liquid radioactive waste underground storage tanks (LLLW USTs), for possible interim corrective measures and/or ultimate closure. The ranking of LLLW USTs is needed to ensure that tanks with the greatest potential for adverse impact on the environment and human health receive top priority for further evaluation and remediation. Wastes from the LLLW USTs at Oak Ridge National Laboratory were pumped out when the tanks were removed from service. The residual liquids and sludge contain a mixture of radionuclides and chemicals. Contaminants of concern that were identified in the liquid phase of the inactive LLLW USTs include the radionuclides ^{90}Sr, ^{137}Cs, and ^{233}U and the chemicals carbon tetrachloride, trichloroethane, tetrachloroethene, methyl ethyl ketone, mercury, lead, and chromium. The risk-based approach for prioritization of the LLLW USTs is based upon three major criteria: (1) leaking characteristics of the tank, (2) location of the tanks, and (3) toxic potential of the tank contents. Leaking characteristics of LLLW USTs will aid in establishing the potential for the release of contaminants to environmental media. In this study, only the liquid phase was assumed to be released to the environment. Scoring criteria for release potential of LLLW USTs was determined after consideration of the magnitude of any known leaks and the tank type for those that are not known to leak.

2765 (ORNL/ER–136) **Design report on the test system used to assess treatment of trench water from Waste Area**

Grouping 6 at Oak Ridge National Laboratory, Oak Ridge, Tennessee: Environmental Restoration Program. Kent, T.E.; Taylor, P.A. Oak Ridge National Lab., TN (United States). Environmental Restoration Div. Sep 1992. 21p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. Order Number DE92041014. Source: OSTI; NTIS; GPO Dep.

New liquid waste streams will be generated as a consequence of closure activities at Waste Area Grouping (WAG) 6 at Oak Ridge National Laboratory (ORNL). It is proposed that these waste streams be treated for removal of contaminants by adding them to the ORNL wastewater treatment facilities. Previous bench-scale treatability studies indicate that ORNL treatment operations will adequately remove the contaminants, although additional study is required to characterize the secondary waste materials produced as a result of the treatment. A larger scale treatment system was constructed to produce secondary wastes in the quantities necessary for characterization and US Environmental protection Agency toxicity characteristic leaching procedure (TCLP) testing. The test system is designed to simulate the operation of the ORNL process waste treatment facilities and to treat a mixture of ORNL process wastewater and WAG 6 wastewater at a combined flow rate of 0.5 L/min. The system is designed to produce the necessary quantities of waste sludges and spent carbon for characterization studies and TCLP testing.

2766 (ORNL/ER–137) **Preliminary report on the ecological assessment of Waste Area Grouping 5 at Oak Ridge National Laboratory, Oak Ridge, Tennessee: Environmental Restoration Program.** Ashwood, T.L.; Suter, G.W. II; Stewart, A.J. Oak Ridge National Lab., TN (United States). Sep 1992. 36p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. Order Number DE93000547. Source: OSTI; NTIS; GPO Dep.

In support of the remedial investigation for Waste Area Grouping (WAG) 5, staff of the Environmental Sciences Division of Oak Ridge National Laboratory have conducted preliminary ecological assessment activities. A screening level ecological risk assessment has been completed, ambient toxicity tests have been conducted on streams and seeps within WAG 5, WAG 5 has been surveyed for rare and endangered species and wetlands, and wild turkeys that may feed on contaminated vegetation and insects in WAG 5 have been screened for beta-emitting isotopes and ^{137}Cs. The screening-level ecological risk assessment identified some data gaps that were addressed in the ecological assessment plan. These include gaps in data on the toxicity of surface water and soil within WAG 5 and on the status of rare and endangered species. In addition, the screening-level risk assessment identified the need for data on the level of contaminants in wild turkeys that may be consumed by predatory wildlife and humans. Three rounds of ambient toxicity tests on six streams and seeps, using the microcrustacean Ceriodaphnia, have identified potential toxicity in three of the sample sites. Further tests are required to identify the toxicant. No rare or endangered animal species have been identified in the WAG 5 area.

2767 (ORNL/ER–154) **Investigation of groundwater flow zones and contaminant transport in Solid Waste Storage Area 5 at Oak Ridge National Laboratory, Oak Ridge, Tennessee: Environmental Restoration Program.** Hicks, D.S.; Solomon, D.K.; Farrow, N.D. Oak Ridge National Lab., TN (United States). Sep 1992. 27p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. Order Number DE93000548. Source: OSTI; NTIS; GPO Dep.

Environmental Sciences Division Publication 3977.

An understanding of subsurface transport processes is essential to produce realistic predictions of future contaminant discharge from Solid Waste Storage Areas (SWSAs) at Oak Ridge National Laboratory (ORNL). Locating groundwater flow zones (permeable pathways) and determining the relative contributions of primary vs secondary contaminant sources are critical to the proper selection and evaluation of remedial actions. Because groundwater discharge from SWSA 5 contributes significant amounts of ^{3}H and ^{90}Sr to the White Oak Creek watershed, an area on the southeastern edge of SWSA 5 was chosen for an investigation aimed at understanding and characterizing the subsurface movement of contaminants. Preliminary data collected in 1991 indicated that the vertical distribution of ^{3}H (0.02 to 279 μCi/L) observed over the sampled interval (O to 10 ft deep) may be a result of upward diffusion from a hydraulically dominant fracture (or fractured zone) below the sampled interval. The investigation continued this year (1992) with the primary objective of defining where the most permeable zones exist in the subsurface and how they relate to the vertical extent of ^{3}H. An open borehole was drilled on the southeastern edge of SWSA 5 through the upper zones of soil and saprolite and then through interbedded shales and limestones to a depth of about 26 ft. Two methods were used to determine permeable zones within the borehole. In addition, samples were collected monthly from a nearby well and seep (where tritiated groundwater discharges) to determine seasonal variability in the transport of ^{3}H and ^{90}Sr from the study area.

2768 (ORNL/ER/Sub–90-LJ068/1) **Risk characterization data manual for inactive liquid low-level waste tank systems at Oak Ridge National Laboratory, Oak Ridge, Tennessee.** Oak Ridge National Lab., TN (United States). Environmental Restoration Div.; H and R Technical Associates, Inc., Oak Ridge, TN (United States). Sep 1992. 52p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. Order Number DE92041218. Source: OSTI; NTIS; INIS; GPO Dep.

This manual reports the results of a risk characterization of inactive liquid low-level radioactive waste (LLLW) underground storage tanks (USTs) at the Oak Ridge National Laboratory (ORNL). Of the 39 tanks at ORNL that have been accepted into the Environmental Restoration Program, the 29 LLLW USTs that have been sampled for preliminary characterization were considered. Each tank was scored on a scale of 1 to 5 on the basis of three criteria: (1) leak characteristics, (2) location, and (3) toxicological characteristics of residual sludges and liquids. Each criterion was then weighted according to perceived importance. The criterion score multiplied by the weighting factor equaled the tank's total score for that criterion. The three weighted criterion scores for each tank were then summed for a total score for that tank. When the scores for all tanks had been weighted and summed, the tanks were ranked in descending order on the basis of their total scores. The highest possible score for a tank is 30. The descending rank order represents the recommended priorities for evaluation: the higher the score, the higher the priority for evaluation.

2769 (ORNL/M–1792) **Active Sites Environmental Monitoring Program: FY 1991 report.** Ashwood, T.L.; Hicks, D.S.; Morrissey, C.M. Oak Ridge National Lab., TN (United States). Nov 1992. 39p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. Order Number DE93003064. Source: OSTI; NTIS; INIS; GPO Dep.

Environmental Sciences Division Publication No. 3798.

This report summarizes the activities of the Active Sites Environmental Monitoring Program (ASEMP) from April 1991 through September 1991. The ASEMP was established in 1989 by Solid Waste Operations (SWO) and the Environmental Sciences Division, both of Oak Ridge National Laboratory, to provide early detection and performance monitoring at active low-level (radioactive) waste (LLW) disposal sites in Solid Waste Storage Area (SWSA) 6 and transuranic (TRU) waste storage sites in SWSA 5 as required by chapters II and III of US Department of Energy Order 5820.2A. A new set of action levels was developed on the basis of a statistical analysis of background contamination. These new action levels have been used to evaluate results in this report. Results of ASEMP monitoring continue to demonstrate that no LLW (except ^{3}H) is being leached from the storage vaults on the tumulus pads. Loading of vaults on Tumulus II, which began in early FY 1991, was >90% complete at the end of September 1991. Results of sampling of groundwater and surface waters is presented.

2770 (ORNL/TM–12036) **In-tank evaporator demonstrations during 1990/1991 at the ORNL Melton Valley Storage Tanks.** Walker, J.F. Jr.; Perona, J.J.; Robinson, S.M. Oak Ridge National Lab., TN (United States). Oct 1992. 29p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. Order Number DE93002410. Source: OSTI; NTIS; GPO Dep.

The results of this report indicate that in-tank evaporation (ITE) should be continued to reduce the inventory of supernate in the Melton Valley Storage Tanks (MVST) until additional storage tanks and/or treatment facilities can be installed. Several equipment problems were encountered during the initial operation of the ITE. All of these have been addressed with the exception of the replacement of the air compressor that was originally used in the hydrofracture process and the intermittent wetting of the high efficiency particulate air (HEPA) filters. The compressor is being replaced with a unit that is designed for continuous operation. Filter wetting needs further investigation. ITE will help reduce the supernate inventory in the MVST using the existing equipment but will not eliminate the need for solidification campaigns. Several options are available to increase the evaporation rate above that achieved in this study to minimize dependence on solidification campaigns until new tanks and/or treatment systems become available. These include increasing the air sparge flow rate through the MVST, adding heat to the MVST, and pumping the supernate to an evaporator located near the MVST. Evaluations of the feasibility and cost effectiveness for the more promising options began in FY 1991 and will continue in FY 1992.

2771 (PNL-SA–20710) **Retrieval technology development for Hanford double-shell tanks.** Bamberger, J.A.; Wise, B.M.; Miller, W.C. Pacific Northwest Lab., Richland, WA (United States). May 1992. 7p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. (CONF-920851–79: Spectrum '92: nuclear and hazardous waste management international topical meeting, Boise, ID (United States), 23-27 Aug 1992). Order Number DE93001310. Source: OSTI; NTIS; INIS; GPO Dep.

This paper describes the combined analytical, computational, and experimental program developed for identifying operating strategies for mobilization and retrieval of radioactive waste stored in double-shell tanks at Hanford. Sludge mobilization, slurry uniformity, and slurry retrieval investigations will produce guidelines for mixer pump and retrieval pump operation based on the physical properties of the waste and the geometric properties of the system (number of operating pumps and pump design and placement).

2772 (PNL-SA–20912) **Development of simulated tank wastes for the US Department of Energy's Underground Storage Tank Integrated Demonstration.** Elmore, M.R.; Colton, N.G.; Jones, E.O. Pacific Northwest Lab., Richland, WA (United States). Aug 1992. 9p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. (CONF-920851–73: Spectrum '92: nuclear and hazardous waste management international topical meeting, Boise, ID (United States), 23-27 Aug 1992). Order Number DE92041340. Source: OSTI; NTIS; INIS; GPO Dep.

The purpose of the Underground Storage Tank Integrated Demonstration (USTID) is to identify and evaluate technologies that may be used to characterize, retrieve, treat, and dispose of hazardous and radioactive wastes contained in tanks on US Department of Energy sites. Simulated wastes are an essential component of the evaluation process because they provide controlled samples for technology assessment, and minimize costs and risks involved when working with radioactive wastes. Pacific Northwest Laboratory has developed a recipe to simulate Hanford single-shell tank, (SST) waste. The recipe is derived from existing process recipes, and elemental concentrations are based on characterization data from 18 SSTs. In this procedure, salt cake and metal oxide/hydroxide sludge are prepared individually, and mixed together at varying ratios depending on the specific tank, waste to be simulated or the test being conducted. Elemental and physical properties of the stimulant are comparable with analyzed tank samples, and chemical speciation in the simulant is being improved as speciation data for actual wastes become available. The nonradioactive chemical waste simulant described here is useful for testing technologies on a small scale.

2773 (PNL-SA–21215) **The Hybrid Treatment Process for mixed radioactive and hazardous waste treatment.** Ross, W.A.; Kindle, C.H. Pacific Northwest Lab., Richland, WA (United States). Jun 1992. 15p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. (CONF-920808–11: American Institute of Chemical Engineers (AIChE) summer national meeting, Minneapolis, MN (United States), 9-12 Aug 1992). Order Number DE93001307. Source: OSTI; NTIS; INIS; GPO Dep.

This paper describes a new process for treating mixed hazardous and radioactive waste, commonly called mixed waste. The process is called the Hybrid Treatment Process (HTP), so named because it is built on the 20 years of experience with vitrification of wastes in melters, and the 12 years of experience with treatment of wastes by the in situ vitrification (ISV) process. It also uses techniques from several additional technologies. Mixed wastes are being generated by both the US Department of Energy (DOE) and by commercial sources. The wastes are those that contain both a hazardous waste regulated under the US Environmental Protection Agency's (EPA) Resource, Conservation, and Recovery Act (RCRA) regulations and a radioactive waste with source, special nuclear, or byproduct materials. The dual regulation of the wastes increases the complexity of the treatment, handling, and storage of the waste. The DOE is the largest holder and generator of mixed waste. Its mixed wastes are classified as either high-level, transuranic (TRU), or low-level waste (LLW). High-level mixed wastes will be treated in vitrification plants. Transuranic wastes may be disposed of without treatment by obtaining a no-migration variance from the EPA. Lowlevel wastes, however, will require treatment, but treatment systems with sufficient capacity are not yet available to DOE. Various facilities are being proposed for the treatment of low-level waste. The concept described in this paper represents one option for establishing that treatment capacity.

2774 (POEF–3010) **Integrated waste storage plan.** Warner, C.L. Portsmouth Gaseous Diffusion Plant, OH (United States). Sep 1992. 34p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-76OR00001. Order Number DE93001859. Source: OSTI; NTIS; INIS; GPO Dep.

The purpose of this document is to assess the Portsmouth Gaseous Diffusion Plant (PORTS) Uranium Enrichment process and Environmental Restoration waste storage integration, assuming no off-site shipments other than currently approved avenues and no off-site disposal.

2775 (SAND–91-7038) **Performance prediction of mechanical excavators from linear cutter tests on Yucca Mountain welded tuffs: Yucca Mountain Site Characterization Project.** Gertsch, R. (Colorado School of Mines, Golden, CO (United States). Earth Mechanics Inst.); Ozdemir, L. Sandia National Labs., Albuquerque, NM (United States); Colorado School of Mines, Golden, CO (United States). Earth Mechanics Inst. Sep 1992. 98p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-76DP00789. Order Number DE93002513. Source: OSTI; NTIS; INIS; GPO Dep.

The performances of mechanical excavators are predicted for excavations in welded tuff. Emphasis is given to tunnel boring machine evaluations based on linear cutting machine test data obtained on samples of Topopah Spring welded tuff. The tests involve measurement of forces as cutters are applied to the rock surface at certain spacing and penetrations. Two disc and two point-attack cutters representing currently available technology are thus evaluated. The performance predictions based on these direct experimental measurements are believed to be more accurate than any previous values for mechanical excavation of welded tuff. The calculations of performance are predicated on minimizing the amount of energy required to excavate the welded tuff. Specific energy decreases with increasing spacing and penetration, and reaches its lowest at the widest spacing and deepest penetration used in this test program. Using the force, spacing, and penetration data from this experimental program, the thrust, torque, power, and rate of penetration are calculated for several types of mechanical excavators. The results of this study show that the candidate excavators will require higher torque and power than heretofore estimated.

2776 (SSI-P–569-90) **Radiological consequences of drilling intrusion into a deep repository for high level waste.** Charles, D. (Intera Sciences, Henly-on-Thames (United Kingdom)); McEwen, T.J. Swedish Radiation Protection Inst., Stockholm (Sweden). Jan 1991. 42p. Order Number DE93607969. Source: OSTI; NTIS; INIS.

This report provides estimates of maximum annual individual doses to personnel for given set of scenarios associated with intrusion by drilling into a deep repository for high level waste (HLW) and recovery to the surface of contaminated material. Geological and engineering judgment has been used to formulate the manner of this intrusion and the parameters which would determine the resulting doses to field workers and to others who might be involved subsequently in procedures carried out in a geotechnical laboratory. Calculations have been performed to quantify the magnitudes of doses resulting from drilling into the HLW spent fuel matrix, the bentonite buffer and the adjacent rock. Doses have been calculated in the basis of the potential for external irradiation, inhalation of suspended contamination, and inadvertent ingestion of small amounts of contaminated material. The results show that intrusion doses into spent fuel within a few decades of disposal could be very high, in the range about 10 to 100 Sv. At this stage all three exposure pathways make a significant contribution to the total dose. Beyond about 100 y, as ^{137}Cs decays away, the contribution from external irradiation falls off sharply. However the doses from ingestion and inhalation have only fallen by about a factor of 5 after 10^3 y, and the total dose still in the range from about 2 to 25 Sv. Apart form the direct consequences of intrusion discussed above, drilling might influence safety in other ways. Thus, a borehole might modify the groundwater flow system around the waste, and provide a direct permeable flow path to the near surface; it might results in the introduction of drilling fluids which modify groundwater chemistry; it might results in the early failure of a fuel canister, leading to earlier release to groundwater; or, in the extreme, some combination of all three. (au).

2777 (UCRL-ID–109921) **Modeling fluid-rock interaction at Yucca Mountain, Nevada: A progress report, April 15, 1992.** Viani, B.E.; Bruton, C.J. Lawrence Livermore National Lab., CA (United States). Aug 1992. 72p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. Order Number DE92041080. Source: OSTI; NTIS; INIS; GPO Dep.

Volcanic rocks at Yucca Mountain, Nevada aie being assessed for their suitability as a potential repository for high-level nuclear waste. Recent progress in modeling fluid-rock interactions, in particular the mineralogical and chemical changes that may accompany waste disposal at Yucca Mountain, will be reviewed in this publication. In Part 1 of this publication, "Geochemical Modeling of Clinoptilolite-Water Interactions," solid-solution and cation-exchange models for the zeolite clinoptilolite are developed and compared to experimental and field observations. At Yucca Mountain, clinoptilolite which is found lining fractures and as a major component of zeolitized tuffs, is expected to play an important role in sequestering radionuclides that may escape from a potential nuclear waste repository. The solid-solution and ion-exchange models were evaluated by comparing predicted stabilities and exchangeable cation distributions of clinoptilolites with: (1) published binary exchange data; (2) compositions of coexisting clinoptilolites and formation waters at Yucca Mountain; (3) experimental sorption isotherms of Cs and Sr on zeolitized tuff, and (4) high temperature experimental data. Good agreement was found between predictions and expertmental data, especially for binary exchange and Cs and Sr sorption on clinoptilolite. Part 2 of this publication, "Geochemical Simulation of Fluid-Rock Interactions at Yucca Mountain," describes preliminary numerical simulations of fluid-rock interactions at Yucca Mountain. The solid-solution model developed in the first part of the paper is used to evaluate the stability and composition of clinciptilolite and other minerals in the host rock under ambient conditions and after waste emplacement.

2778 (VTT-SYMP–126, pp. 9-14) **Modelling of ground water movement and transport of radioactive substances in performance assessments of nuclear waste disposal.** Vuori, S. (Technical Research Centre of Finland, Espoo (Finland). Nuclear Engineering Lab.). Technical Research Centre of Finland, Espoo (Finland). 1991. (In Finnish). (CONF-9105387–: Seminar on ground water modelling, Espoo (Finland), 9 May 1991). In *Ground water modelling.* 156p. Order Number DE93607107. Source: OSTI; NTIS; INIS.

Safety analyses and performance assessments for nuclear waste repositories include the survey of possible phenomena, events and processes, which might endanger the safety of disposal systems. Secondly the probabilities of disruptive events caused either by natural events or by human actions have to be assessed. Thirdly the radiological consequences of different scenarios are analyzed. The most comprehensive part of the consequence estimation is the analysis of the groundwater flow and transport of radionuclides within the engineered barriers of the repository and in the geosphere.

2779 (VTT-SYMP–126, pp. 15-20) **Transport of radionuclides in bedrock and soil.** Hautojaervi, A. (Technical Research Centre of Finland, Espoo (Finland). Nuclear Engineering Lab.); Rasilainen, K. Technical Research Centre of Finland, Espoo (Finland). 1991. (In Finnish). (CONF-9105387–: Seminar on ground water modelling, Espoo (Finland), 9 May 1991). In *Ground water modelling.* 156p. Order Number DE93607107. Source: OSTI; NTIS; INIS.

Migrating species experience medium-specific hydrogeological phenomena common to all species and species-specific phenomena, that depend on the species, the carrier (groundwater) and the medium (e.g. bedrock). Various analytical and numerical computer programs are developed to handle migration problems in various applications. Most computer programs have a similar conceptual model as basis for the numerical model.

2780 (VTT-SYMP–126, pp. 21-33) **Geochemical modelling in nuclear waste studies.** Ollila, K. (Technical Research Centre of Finland, Espoo (Finland). Reactor Lab.); Olin, M. Technical Research Centre of Finland, Espoo (Finland). 1991. (In Finnish). (CONF-9105387–: Seminar on ground water modelling, Espoo (Finland), 9 May 1991). In *Ground water modelling.* 156p. Order Number DE93607107. Source: OSTI; NTIS; INIS.

At the Reactor Laboratory geochemical models are applied to study the water chemical conditions and interactions under the disposal conditions of nuclear waste, as well as to study the dissolution mechanism of spent fuel under the defined conditions. Additionally, the experimental conditions used in laboratory are modelled with these codes, e.g. the chemistry of groundwater in closed anoxic system, the dissolution studies of unirradiated UO_2 fuel.

2781 (VTT-SYMP–126, pp. 34-44) **Geochemical modelling of groundwater evolution using chemical equilibrium codes.** Pitkaenen, P. (Technical Research Centre of Finland, Espoo (Finland). Road and Traffic Lab.); Pirhonen, V. Technical Research Centre of Finland, Espoo (Finland). 1991. (In Finnish). (CONF-9105387–: Seminar on ground water modelling, Espoo (Finland), 9 May 1991). In *Ground water modelling.* 156p. Order Number DE93607107. Source: OSTI; NTIS; INIS.

Geochemical equilibrium codes are a modern tool in studying interaction between groundwater and solid phases. The most common used programs and application subjects are shortly presented in this article. The main emphasis is laid on the approach method of using calculated results in evaluating groundwater evolution in hydrogeological system. At present in geochemical equilibrium modelling also kinetic as well as hydrologic constrains along a flow path are taken into consideration.

2782 (VTT-SYMP–126, pp. 75-80) **Advanced methods and tools in 3-dimensional ground water flow modelling.** Koskinen, L. (Technical Research Centre of Finland, Espoo (Finland). Nuclear Engineering Lab.). Technical Research Centre of Finland, Espoo (Finland). 1991. (In Finnish). (CONF-9105387–: Seminar on ground water modelling, Espoo (Finland), 9 May 1991). In *Ground water modelling.* 156p. Order Number DE93607107. Source: OSTI; NTIS; INIS.

Numerical simulations of the groundwater flow are often based on the finite element method. The geometry of the system is usually very complicated and consequently, the modelling of groundwater flow is arduous and requires a lot of time. At the Technical Research Centre of Finland several tools are developed to ease and to shorten the time needed for the analysis of groundwater flow.

2783 (VTT-SYMP–126, pp. 100-108) **Development of three-dimensional groundwater flow and transport model.** Simbierowicz, P. (Technical Research Centre of Finland, Espoo

(Finland). Reactor Lab.); Olin, M. Technical Research Centre of Finland, Espoo (Finland). 1991. (In Finnish). (CONF-9105387–: Seminar on ground water modelling, Espoo (Finland), 9 May 1991). In *Ground water modelling.* 156p. Order Number DE93607107. Source: OSTI; NTIS; INIS.

Combination of automatic bin-/quad-/octree mesh generators with multigrid technique yields a novel highly sophisticated approach to modelling many physical processes, especially those governed by elliptic partial differential equations. This is not only 'just another mathematical method', but a new philosophy, a new methodology, which takes into account the very important 'fractal' feature of the nature. The new method performs with optimal efficiency even for highly anisotropic/inhomogeneous problems and badly scattered data. The efficiency is partly due to the fast adaptive grid generation in which the resolution follows automatically the density of the available information, and partly due to the robustness of the multigrid algorithm. In the present paper we have applied the new 'tree-multigrid' approach to groundwater flow and migration problems.

2784 (VTT-SYMP–126, pp. 109-114) **A ground water flow analysis for a nuclear waste repository excavated in bedrock.** Taivassalo, V. (Technical Research Centre of Finland, Espoo (Finland). Nuclear Engineering Lab.). Technical Research Centre of Finland, Espoo (Finland). 1991. (In Finnish). (CONF-9105387–: Seminar on ground water modelling, Espoo (Finland), 9 May 1991). In *Ground water modelling.* 156p. Order Number DE93607107. Source: OSTI; NTIS; INIS.

An important part of the safety analysis of an underground disposal facility is the assessment of groundwater flow in the repository and the host rock. The groundwater flow analysis is required to produce the overall flow field as well as the flow rate through the repository, the flow paths (including lengths and transit times) into the biosphere, and the dilution factor in the geosphere.

2785 (WHC-EP–0182-48) **Tank farm surveillance and waste status summary report for March 1992.** Hanlon, B.M. Westinghouse Hanford Co., Richland, WA (United States). Jun 1992. 108p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-87RL10930. Order Number DE93001754. Source: OSTI; NTIS; GPO Dep.

This report is the official inventory for radioactive waste stored in underground tanks in the 200 Areas at the Hanford Site. Data that depict the status of stored radioactive waste and tank vessel integrity are contained within the report. The intent of the report is to provide data on each of the existing 177 large underground waste storage tanks and 49 smaller catch tanks and special surveillance facilities, and to provide supplemental information regarding tank surveillance anomalies and ongoing investigations.

2786 (WHC-EP–0182-50) **Tank Farm surveillance and waste status summary report for May 1992.** Hanlon, B.M. Westinghouse Hanford Co., Richland, WA (United States). Aug 1992. 111p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-87RL10930. Order Number DE93001666. Source: OSTI; NTIS; GPO Dep.

This report is the official inventory for radioactive waste stored in underground tanks in the 200 Areas at the Hanford Site. Data that depict the status of stored radioactive waste and tank vessel integrity are contained within the report. This report provides data on each of the existing 177 large underground waste storage tanks and 49 smaller catch tanks and special surveillance facilities, and provides supplemental information regarding tank surveillance anomalies and ongoing investigations. This report is intended to meet the requirement of US Department of Energy-Richland Operations Office Order 5820.2A, Chapter I, Section 3.e.(3) (DOE-RL, 1990, Radioactive Waste Management, US Department of Energy-Richland Operations Office, Richland, Washington) requiring the reporting of waste inventories and space utilization for Hanford Tank Farm Tanks.

2787 (WHC-EP–0182-51) **Tank Farm surveillance and waste status summary report for June 1992.** Hanlon, B.M. Westinghouse Hanford Co., Richland, WA (United States). Sep 1992. 108p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-87RL10930. Order Number DE93001755. Source: OSTI; NTIS; GPO Dep.

This report is the official inventory for radioactive waste stored in underground tanks in the 200 Areas at the Hanford Site. Data that depict the status of stored radioactive waste and tank vessel integrity are contained within the report. This report provides data on each of the existing 177 large underground waste storage tanks and 49 smaller catch tanks and special surveillance facilities, and provides supplemental information regarding tank surveillance anomalies and ongoing investigations. This report is intended to meet the requirement of US Department of Energy-Richland Operations Office Order 5820.24, Chapter I, Section 3.e.(3) (DOE-RL, 1990, Radioactive Waste Management, O.S. Department of Energy-Richland Operations Office, Richland, Washington) requiring the reporting of-waste inventories and space utilization for Hanford Tank Farm Tanks.

2788 (WHC-EP–0393-Rev.2-Pt.1) **Hanford Waste Vitrification Plant Quality Assurance Program description: Overview and applications: Revision 2, Part 1.** Weber, J. Westinghouse Hanford Co., Richland, WA (United States). Aug 1992. 12p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-87RL10930. Order Number DE93001452. Source: OSTI; NTIS; INIS; GPO Dep.

This document describes the Hanford Waste Vitrification Plant Project Quality Assurance Program. This program is being implemented to ensure the acceptability of high-level radioactive canistered waste forms produced by the Hanford Waste Vitrification Plant for disposal in a licensed federal repository. Four activities included in the Waste Acceptance Process are as follows: (1) preparation of the Waste Acceptance Specification, (2) preparation and implementation of a Waste Form Compliance Plan, (3) preparation of a Waste Form Qualification Report, and (4) assembly of the Production Records package. The Hanford Waste Vitrification Plant Quality Assurance Program comprises this Quality Assurance Program Description as well as the Hanford Waste Vitrification Plant Project Participants' quality assurance programs.

2789 (WHC-EP–0516) **Mitigation/remediation concepts for Hanford Site flammable gas generating waste tanks.** Babad, H. (Westinghouse Hanford Co., Richland, WA (United States)); Deichman, J.L.; Johnson, B.M.; Lemon, D.K.; Strachan, D.M. Westinghouse Hanford Co., Richland, WA (United States). Apr 1992. 150p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-87RL10930. Order Number DE93001676. Source: OSTI; NTIS; GPO Dep.

This report presents a preliminary assessment of concepts for the mitigation and/or remediation of the hydrogen gas generation, storage, and periodic release in Tank 241-SY-101 (101-SY) and 22 other tanks. The 22 other tanks exhibit much less hydrogen generation (volume and concentration of released flammable gases) than Tank 101-SY and have not had the focus nor attention that has been given to Tank 101-SY. These tanks have been listed as potential hydrogen gas-generating tanks from analysis of tank performance and data from flowsheets and Track Radioactive Constituents Reports (TRAC). These lesser hydrogen-generating tanks will also need to be revisited and revalidated. Of the 23 hydrogen class tanks, 5 are double-shell tanks (DST) and 18 are single-shell tanks (SST). Options for mitigation or remediation are different for the two types of tanks because of age, configuration, and waste form. While this document principally focuses on Tank 101-SY, the information presented has been useful to address other tanks containing hydrogen-generating waste.

2790 (WHC-EP–0563) **Upgrade activities for the Criticality Safety Program of Hanford High-Level Radioactive Waste Tank Farm.** Vail, T.S. Westinghouse Hanford Co., Richland, WA (United States). Sep 1992. 47p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-87RL10930. Order Number DE93001667. Source: OSTI; NTIS; INIS; GPO Dep.

This document describes the plan for implementing the findings and recommendations made by a team of experts for the US Department of Energy in their Nuclear Criticality Safety Review Of Hanford High-Level Radioactive Waste Tank Farms. The team was chartered to review the nuclear criticality safety of the tank farms

and recommend programmatic changes where appropriate, including the specific incident leading to an Unusual Occurrence Report filed in June 1991 on the 241-C-104 specification violation. Although no imminent risks of criticality were found, the review team identified several problems with respect to nuclear criticality safety. Primary among the problems is the Tack of dofinitive knowledge of the fissile material inventory and distribution within the tanks. The lack of good characterization data prompted Westinghouse Hanford Company to declare an Unreviewed Safety Question with respect to criticality safety. Activities by the responsible Hanford Site contractor that address each of the findings, recommendations, and activities required to resolve the Unreviewed Safety Question are described. Schedules and estimated costs are also included with the plan.

2791 (WHC-EP–0570) **The distillation and incineration of 132,000 liters (35,000 gallons) of mixed-waste hexone solvents from Hanford's REDOX Plant.** Rasmussen, O.R.; Cowan, R.J.; Heine, W.F. Westinghouse Hanford Co., Richland, WA (United States). Sep 1992. 30p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-87RL10930. Order Number DE93001752. Source: OSTI; NTIS; GPO Dep.

The Westinghouse Hanford Company has successfully decontaminated 132,000 t (35,000 gal) of radioactive hazardous waste solvents and destroyed the solvents by commercial Incineration. The solvents, a mixture of hexone (methyl isobutyl ketone), kerosene, and tributyl phosphate were the extractants in the Reduction Oxidation nuclear fuel reprocessing plant in the 1960's and were stored in carbon-steel underground tanks since the plant shut down in 1967. Westinghouse Hanford Company decontaminated the solvent in a distillation system specially designed to accumulate the radioactive distillation tars in sacrificial vessels for disposal. The distillate, essentially Free of radionuclides except for tritium, was shipped in 19,000-L (5,000-gallon) tank trailer loads to a licensed and permitted commercial incinerator that used the solvents' fuel value to produce electric power in a co-generation plant. This successful recovery operation made beneficial use of a material that once posed a significant environmental risk at the Hanford Site. The project was made possible through technology demonstration funding provided by the US Department of Energy's Office of Technology Development and its predecessor, the Hazardous Waste Remedial Action Program.

2792 (WHC-SP–0126-3) **Westinghouse Hanford Company plan for certifying newly generated contact-handled transuranic waste for emplacement in the Waste Isolation Pilot Plant.** Lipinski, R.M.; Sheehan, J.S. Westinghouse Hanford Co., Richland, WA (United States). Jul 1992. 20p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-87RL10930. Order Number DE93001451. Source: OSTI; NTIS; INIS; GPO Dep.

Westinghouse Hanford Company (Westinghouse Hanford) currently manages an interim storage site for Westinghouse Hanford and non-Westinghouse Hanford-generated transuranic (TRU) waste and operates TRU waste generating facilities within the Hanford Site in Washington State. Approval has been received from the Waste Acceptance Criteria Certification Committee (WACCC) and Westinghouse Hanford TRU waste generating facilities to certify newly generated contact-handled TRU (CH-TRU) solid waste to meet the Waste Acceptance Criteria (WAC). This document describes the plan for certifying newly generated CH-TRU solid waste to meet the WAC requirements for storage at the Waste Isolation Pilot Plant (WIPP) site. Attached to this document are facility-specific certification plans for the Westinghouse Hanford TRU waste generators that have received WACCC approval. The certification plans describe operations that generate CH-TRU solid waste and the specific procedures by which these wastes will be certified and segregated from uncertified wastes at the generating facilities. All newly generated CH-TRU solid waste is being transferred to the Transuranic Storage and Assay Facility (TRUSAF) and/or a controlled storage facility. These facilities will store the waste until the certified TRU waste can be sent to the WIPP site and the non-certified TRU waste can be sent to the Waste Receiving and Processing Facility. All non-certifiable TRU waste will be segregated and clearly identified.

2793 (WHC-SP–0665-2) **Environmental radiological survey summary, 100, 200, 300, and 600 Areas: Third quarter 1991.** Huckfeldt, C.R. Westinghouse Hanford Co., Richland, WA (United States). [1991]. 28p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-87RL10930. Order Number DE93001469. Source: OSTI; NTIS; GPO Dep.

This report provides a summary of the radiological surveys performed on environmental waste sites near facilities located in the 100, 200, 300 and 600 areas of the Hanford reservation. The Third Quarter 1991 survey results and the status of actions required from current and past reports are summarized below: There were 101 routine environmental radiological surveys completed during July, August and September 1991. No Surveillance and Compliance Inspection Reports (SCIR) were issued for sites found out of compliance with standards identified in the Environmental Compliance Manual,WHC-CM-7-Eight SCIRs were closed as a result of corrective actions taken during the third quarter of 1991 and are summarized in Section 5.2 of this report. Thirty-four SCIRS, summarized in Table 5.4, had not been resolved.

2794 (WHC-SP–0665-3) **Quarterly environmental radiological survey summary: Fourth quarter 1991, 100, 200, 300 and 600 areas.** Webb, C.R. Westinghouse Hanford Co., Richland, WA (United States). Jan 1992. 32p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-87RL10930. Order Number DE93001470. Source: OSTI; NTIS; GPO Dep.

This report provides a summary of the radiological surveys performed on environmental waste sites near facilities located in the 100, 200, 300, 600 areas of the Hanford reservation. The Fourth Quarter 1991 survey results and the status of actions required from current and past reports are summarized below: There were 97 routine environmental radiological surveys completed during October, November and December 1991. One Surveillance and Compliance Inspection Reports (SCIR) was issued for sites found out of compliance with standards identified in the Environmental Compliance Manual,WHC-CM-7-5. Four SCIRs were closed as a result of corrective actions taken during the fourth quarter of 1991 and are summarized in Section 5.2 of this report. Thirty SCIRs, summarized in Table 5.4, had not been resolved.

2795 (WHC-SP–0665-4) **Quarterly environmental radiological survey summary: First quarter, 1992, 100, 200, 300, and 600 Areas.** Webb, C.R. Westinghouse Hanford Co., Richland, WA (United States). Apr 1992. 29p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-87RL10930. Order Number DE93001467. Source: OSTI; NTIS; GPO Dep.

This report provides a summary of the radiological surveys performed on environmental waste sites near facilities located in the 100, 200, 300 and 600 areas of the Hanford reservation. The First Quarter 1992 survey results and the status of actions required from current and past reports are summarized below: There were 76 routine environmental radiological surveys completed during January, February and March 1992. One Surveillance and Compliance Inspection Report (SCIR) was issued for sites found out of compliance with standards identified in the Environmental Compliance Manual, WHC-CM-7-5. Two SCIRs were closed as a result of corrective actions taken during the first quarter of 1992 and are summarized in Section 5.2 of this report. Twenty-nine SCIRS, sumarized in Table 5.4, had not been resolved.

2796 (WSRC-MS–91-555) **Development of glass vitrification at SRL as a waste treatment technique for nuclear weapon components.** Coleman, J.T.; Bickford, D.F. Westinghouse Savannah River Co., Aiken, SC (United States). [1991]. 6p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC09-89SR18035. (CONF-920851–77: Spectrum '92: nuclear and hazardous waste management international topical meeting, Boise, ID (United States), 23-27 Aug 1992). Order Number DE93000594. Source: OSTI; NTIS; INIS; GPO Dep.

This report discusses the development of vitrification for the waste treatment of nuclear weapons components at the Savannah River Site. Preliminary testing of surrogate nuclear weapon electronic waste shows that glass vitrification is a viable, robust treatment method.

2797 (WSRC-MS–92-108) **Relative yields of U-235 fission products measured in a high level radioactive sludge at Savannah River Site.** Bibler, N.E. (Westinghouse Savannah River Co., Aiken, SC (United States)); Coleman, C.J.; Kinard, W.F. Westinghouse Savannah River Co., Aiken, SC (United States). [1992]. 8p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC09-89SR18035. (CONF-920851–76: Spectrum '92: nuclear and hazardous waste management international topical meeting, Boise, ID (United States), 23-27 Aug 1992). Order Number DE92041346. Source: OSTI; NTIS; INIS; GPO Dep.

This paper presents measurements of the concentrations of 42 of the long-lived U-235 fission products in a high-level radioactive waste sludge stored at Savannah River Site. The 42 fision products make up 98% of the waste sludge. We used inductively coupled plasma-mass spectroscopy for the analysis. The relative yields for most of the fission products are in complete agreement with the known relative yields for the beta decay chains of the two asymmetric branches of the slow neutron fission of U-235. Disagreements can be reconciled based on the chemistry of the fission products in the caustic waste sludges, the neutron fluences in SRS reactors, or interferences in the ICP-MS analyses. This paper presents measurements of the concentrations of 42 (98%) of the long-lived U-235 fission products in a high-level radioactive waste sludge stored at the Savannah River Site. We analyzed the sludge with inductively coupled plasma-mass spectroscopy. The relative yields for most of the fission products agree completely with the known relative vields for the beta decay chains of the two asymmetric: branches of the slow neutron fission of U-235. The chemistry of the fission products in the caustic waste sludges, the neutron fluences in SRS reactors, or interferences in the ICP-MS analyses explain the differences in the measured and calculated results.

2798 (WSRC-MS–92-203-Rev.1) **Specialized video systems for use in waste tanks: Revision 1.** Anderson, E.K.; Robinson, C.W.; Heckendorn, F.M. Westinghouse Savannah River Co., Aiken, SC (United States). [1992]. 8p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC09-89SR18035. (CONF-921102–26-Rev.1: Joint American Nuclear Society (ANS)/European Nuclear Society (ENS) international meeting on fifty years of controlled nuclear chain reaction: past, present, and future, Chicago, IL (United States), 15-20 Nov 1992). Order Number DE93002172. Source: OSTI; NTIS; INIS; GPO Dep.

The Robotics Development Group at the Savannah River Site is developing a remote video system for use in underground radioactive waste storage tanks at the Savannah River Site, as a portion of its site support role. Viewing of the tank interiors and their associated annular spaces is an extremely valuable tool in assessing their condition and controlling their operation. Several specialized video systems have been built that provide remote viewing and lighting, including remotely controlled tank entry and exit. Positioning all control components away from the facility prevents the potential for personnel exposure to radiation and contamination. The SRS waste tanks are nominal 4.5 million liter (1.3 million gallon) underground tanks used to store liquid high level radioactive waste generated by the site, awaiting final disposal. The typical waste tank (Figure 1) is of flattened shape (i.e. wider than high). The tanks sit in a dry secondary containment pan. The annular space between the tank wall and the secondary containment wall is continuously monitored for liquid intrusion and periodically inspected and documented. The latter was historically accomplished with remote still photography. The video systems includes camera, zoom lens, camera positioner, and vertical deployment. The assembly enters through a 125 mm (5 in) diameter opening. A special attribute of the systems is they never get larger than the entry hole during camera aiming etc. and can always be retrieved. The latest systems are easily deployable to a remote setup point and can extend down vertically 15 meters (50ft). The systems are expected to be a valuable asset to tank operations.

2799 (WSRC-MS–92-261) **Vitrification of hazardous and mixed wastes.** Jantzen, C.M. (Westinghouse Savannah River Co., Aiken, SC (United States)); Pickett, J.B.; Ramsey, W.G. Westinghouse Savannah River Co., Aiken, SC (United States). [1992]. 7p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC09-89SR18035. (CONF-9209229–3: Industrial and engineering chemistry (I&EC) special symposium of the American Chemical Society (ACS), Atlanta, GA (United States), 21-23 Sep 1992). Order Number DE93001901. Source: OSTI; NTIS; INIS; GPO Dep.

Solidification of hazardous/mixed wastes into glass is being examined at the Savannah River Site. The first hazardous/mixed wastes glassified at SRS have been (1) incinerator and (2) nickel plating line (F006) wastes. Solidification of incinerator blowdown and mixtures of incinerator blowdown and incinerator bottom kiln ash have been achieved in Soda (Na_2O) - Lime (CaO) - Silica (SiO_2) glass (SLS) at waste loadings of up to 50 wt%. Solidification of nickel-plating line waste sludges containing depleted uranium have also been achieved in both SLS and borosilicate glasses at waste loadings of 75 wt%. This corresponds to volume reductions of 97% and 81%, respectively. Further studies will examine glassification of: ion exchange zeolites, inorganic filter media, asbestos, glass fiber filters, contaminated soil, cementitious, or other materials in need of remediation.

2800 (WSRC-RD–92-002-Rev.1) **Method of calculation of heat generation rates for DWPF glass: Revision 1.** Plodinec, M.J. Westinghouse Savannah River Co., Aiken, SC (United States). 17 Mar 1992. 5p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC09-89SR18035. Order Number DE93002175. Source: OSTI; NTIS; INIS; GPO Dep.

The Waste Acceptance Preliminary Specifications (WAPS) require estimates of the heat generation rate of DWPF waste glasses. Estimates of the heat generation rates of projected glass compositions are to be reported in the Waste Form Qualification Report. Similar estimates for actual production glasses are to be reported in the Production Records. In this report, a method of calculating the heat generation rate from the radionuclide inventory is provided. Application of the method to the DWPF Design-Basis glass indicates that the heat generation rate can be accurately estimated from the Sr-90, Y-90, Cs-137, Ba-137m, and Pu-238 contents alone.

2801 (WSRC-RP–92-245) **Overview of a conceptualized waste water treatment facility for the Consolidated Incinerator Facility.** McCabe, D.J. Westinghouse Savannah River Co., Aiken, SC (United States). 7 Feb 1992. 11p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC09-89SR18035. Order Number DE93002170. Source: OSTI; NTIS; INIS; GPO Dep.

The offgas system in the Consolidated Incinerator Facility (CIF) will generate an aqueous waste stream which is expected to contain hazardous, nonhazardous, and radioactive components. The actual composition of this waste stream will not be identified until startup of the facility, and is expected to vary considerably. Wastewater treatment is being considered as a pretreatment to solidification in order to make a more stable final waste form and to reduce disposal costs. A potential treatment scenario has been defined which may allow disposition of this waste in compliance with all applicable regulations. The conceptualized wastewater treatment plant is based on literature evaluations for treating hazardous metals. Laboratory tests hwill be run to verify the design for its ability to remove the hazardous and radioactive components from this waste stream. The predominant mechanism employed for removal of the hazardous and radioactive metal ions is coprecipitation. The literature indicates that reasonably low quantities of hazardous metals can be achieved with this technique. The effect on the radioactive metal ions is not predictable and has not been tested. The quantity of radioactive metal ions predicted to be present in the waste is significantly less than the solubility limit of those ions, but is higher than the discharge guidelines established by DOE Order 5400.5.

2802 (WSRC-TR–91-400) **Integrated DWPF Melter System (IDMS) campaign report: The first two noble metals operations.** Hutson, N.D.; Zamecnik, J.R.; Smith, M.E.; Miller, D.H.; Ritter, J.A. Westinghouse Savannah River Co., Aiken, SC (United States). 6 Jun 1991. 66p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC09-89SR18035. Order Number DE93000639. Source: OSTI; NTIS; INIS; GPO Dep.

The Integrated DWPF Melter System (IDMS) is designed and constructed to provide an engineering-scale representation of the

DWPF melter and its associated feed preparation and off-gas systems. The facility is the first pilot-scale melter system capable of processing mercury, and flowsheet levels of halides and noble metals. In order to characterize the processing of noble metals (Pd, Rh, Ru, and Ag) on a large scale, the IDMS will be operated batchstyle for at least nine feed preparation cycles. The first two of these operations are complete. The major observation to date occurred during the second run when significant amounts of hydrogen were evolved during the feed preparation cycle. The runs were conducted between June 7, 1990 and March 8, 1991. This time period included nearly six months of "fix-up" time when forced air purges were installed on the SRAT MFT and other feed preparation vessels to allow continued noble metals experimentation.

2803 (WSRC-TR–92-171) **Measured leak rates of the temporary seals in DWPF canistered waste forms after three years of on site storage.** Harbour, J.R.; Miller, T.J. Westinghouse Savannah River Co., Aiken, SC (United States). 6 Apr 1992. 6p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC09-89SR18035. Order Number DE93002153. Source: OSTI; NTIS; GPO Dep.

In the summer of 1990 a study was carried out to determine the internal pressure, relative humidity, and chemical composition of the gas within the free volume of four canistered waste forms produced at TNX in May of 1988. Three of these canistered waste forms were sealed only by temporary seals and subsequently stored in the TNX 'boneyard' with no protection. The fourth canister was sealed by upset resistance welding. All three canisters with temporary seals were decontaminated by aqueous frit blasting. It was important to remeasure the leak rates of these seals to ensure that leaktightness had not deteriorated during canister handling and storage prior to the time the experiment were performed. This paper details the results of two separate measurements of the leak rates of these seals.

2804 (WSRC-TR–92-217) **Radioactive demonstration of DWPF product control strategy.** Andrews, M.K.; Bibler, N.E. Westinghouse Savannah River Co., Aiken, SC (United States). 22 Apr 1992. 7p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC09-89SR18035. Order Number DE93002168. Source: OSTI; NTIS; INIS; GPO Dep.

The effectiveness of the product and process control strategies that will be utilized by the Defense Waste Processing Facility (DWPF) was demonstrated during a campaign in the Shielded Cells Facility (SCF) of the Savannah River Technology Center (SRTC). The remotely operated process included the preparation of the melter feed, vitrification in a slurry-fed 1/100th scale melter and analysis of the glass product both for its composition and durability. The campaign processed approximately 10 kg (on a dry basis) of radioactive sludge from Tank 51. This sludge is representative of the first batch of sludge that will be sent to the DWPF for immobilization into borosilicate glass. Additions to the sludge were made based on calculations using the Product Composition Control System (PCCS). Analysis of the glass produced during the campaign showed that a durable glass was produced with a composition similar to that predicted using the PCCS.

2805 (WSRC-TR–92-255) **Evaluation of the DWPF chemical process cell sample condenser in the integrated DWPF melter system.** Zamecnik, J.R. Westinghouse Savannah River Co., Aiken, SC (United States). 15 May 1992. 6p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC09-89SR18035. Order Number DE93002160. Source: OSTI; NTIS; INIS; GPO Dep.

An on-line Analysis system for hydrogen is being added to the Chemical Processing Cell (CPC) in DWPF to ensure that the process does not operate above the lower flammable limit (LFL). The method chosen to measure hydrogen during cold runs is gas chromatography (GC). In order for the GCs to analyze the offgas exiting the SRAT and SME condensers, an additional condenser is required to reduce the dew point of tho sample to below the lowest ambient temperature expected so that no liquid water will enter the GCs. This temperature was chosen to be 10°C.

2806 (Y/ER/Sub–92-99977/1) **Final geotechnical study, DARA Solid Storage Facility, Y-12 Bear Creek Burial Grounds, Oak Ridge, Tennessee: Environmental Restoration Program.** Oak Ridge Y-12 Plant, TN (United States); Ogden Environmental and Energy Services, Knoxville, TN (United States). Jun 1992. 84p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OS21400. Order Number DE92041272. Source: OSTI; NTIS; INIS; GPO Dep.

The DARA Solid Storage Facility is located north of Gate 4 in the Y-12 Bear Creek Burial Grounds. It was constructed to temporarily store contaminated soil excavated during closure of the Oil Retention Ponds project. The ground surface around the perimeter of the building ranges from about 942 feet Mean Sea Level (MSL) to 936 feet MSL Surface drainage is away from the building, with most of the surface runoff flowing into the drainage ditch east of the building. In order for the DARA Solid Storage Facility (SSF) to be a RCRA permitted hazardous waste storage facility, you have informed us that the height of the water in the sediment cannot exceed one foot. The purposes of this study are to: Obtain subsurface data from the soil stored within the DARA Solid Storage Facility; classify the soil samples and conduct pertinent on-site laboratory tests to characterize the physical parameters of the soil; review groundwater information from nearby monitoring wells; review provided piezometer data, and integrate this with Ogden obtained data and analyze both; review other pertinent documents and drawings; comment as to why we believe that there is a reduced flow of water over time from the soil into the sumps; as appropriate, develop recommendations regarding possible methods that can be used to remove additional water from the soil; and provide other comments we believe are pertinent to a geotechnical analysis of the SSF soil-water relationship.

2807 (YJT–92-05) **The design analysis of ACP-canister for nuclear waste disposal.** Raiko, H. (Technical Research Centre of Finland, Espoo (Finland). Nuclear Engineering Lab.); Salo, J. Voimayhtioeiden Ydinjaetetoimikunta, Helsinki (Finland). May 1992. 43p. Order Number DE93607970. Source: OSTI; NTIS; INIS.

The design basis, dimensioning and some manufacturing aspects of the Advanced Cold Process Canister (ACPC) for the nuclear waste disposal is summarized in the report. The strength of the canister has been evaluated in normal design load condition and in extreme high hydrostatic pressure load condition possibly caused by ice age (orig.).

2808 (YJT–92-08) **Solubility and speciation of uranium in the reference waters of TVO-92.** Ollila, K. Voimayhtioeiden Ydinjaetetoimikunta, Helsinki (Finland). Jun 1992. 39p. Order Number DE93607971. Source: OSTI; NTIS; INIS.

The study provides solubilities and speciation of uranium in the reference waters of the TVO-92 safety assessment. Model calculations were undertaken using the geochemical code EQ3/6. First a short review on the dissolution mechanism of the UO_2 matrix of spent fuel and solubility-limiting solid phases is given. Then results of solubility and speciation calculations with the EQ3/6 code are discussed. Lasdy comparison with solubility data obtained in the dissolution studies of UO_2 performed at VTT, and solubility data available in the literature is made. Under oxidizing conditions, the solubility-limiting solid phase of uranium was assumed to be schoepite, $UO_2(OH)_2$. H_2O. This phase or related compound has been found in dissolution experiments with unirradiated UO_2 pellets and spent fuel. In a natural analogue study, schoepite has been identified as an alteration product of natural UO_2 together with a range of uranyl minerals. In reference waters, the solubility of uranium under oxidizing conditions is mainly affected by carbonate content, and the uranium (VI) aqueous speciation is dominated by anionic carbonate completes. The measured solubilities of uranium from powdered UO_2 in synthetic granitic groundwater and bentonite water are in good agreement with the calculated solubilities. Under reducing conditions UO_2 is stable. UO_2(fuel), intended to correspond to the average particle size of UO_2 in spent fuel, was assumed to be the solubility-limiting solid phase of uranium. The uranium (IV) aqueous speciation is dominated by the neutral hydroxide complex. The calculated solubilities for uranium in granitic groundwater are in good agreement with the experimental values, while in bentonite water lower solubilities have been measured.

2809 (YJT–92-09) **Transport processes in the buffer and backfill of spent fuel disposal data for TVO-92 safety analysis.**

Muurinen, A. (Tehnical Research Centre of Finland, Espoo (Finland). Reactor Lab.). Voimayhtioeiden Ydinjaetetoimikunta, Helsinki (Finland). Jun 1992. 148p. Order Number DE93607972. Source: OSTI; NTIS; INIS.

The TVO-92 study is a safety analysis for spent fuel disposal of Teollisuuden Voima Oy (TVO-1 and TVO-2 reactors). The management consept of TVO is direct disposal deep in Finnish crystalline bedrock. In the repository the waste canisters will be surrounded by bentonite clay and the tunnels will be filled by a mixture of quartz sand and bentonite. The reference repository conditions are selected on the basis of the on-going site selection studies so that they represent the conditions in typical Finnish crystalline bedrock. In the study available experimental diffusion and sorption parameters and parameters used in recent safety analyses for buffer and backfill have been compiled. On the basis of the compiled data, diffusion and sorption values in buffer and backfill for TVO-92 study have been proposed (orig.).

2810 (YJT–92-11) **Solubility and speciation calculations (EQ3/6) for the elements of importance in TVO-92.** Vuorinen, U. (Technical Research Centre of Finland, Espoo (Finland). Reactor Lab.); Leino-Forsman, H. Voimayhtioeiden Ydinjaetetoimikunta, Helsinki (Finland). Aug 1992. 74p. Order Number DE93607973. Source: OSTI; NTIS; INIS.

In the TVO-92 safety assessment, five reference waters are considered, of which three are natural groundwaters and two are simulated. The reference waters represent saline, brackish fresh and bentonite-equilibrated groundwaters. Solubility and speciation data in the reference waters for some actinide elements (Am, Np, Pu, Th), as well as for some fission and corrosion products (Cu, Fe, Ni, Ra, Se, Sn, Tc) considered in TVO-92 were obtained by geochemical modelling. The code used for modelling was EQ3/G, of which the EQ3 part of the code was used for obtaining the results in the report. The thermodynamic database used with the code is a modified version of the original data base supporting the code. Modification of the data base has been undertaken by Swedish Nuclear Waste Management Company (SKB). Solubility and speciation of the considered elements are given both in reducing and oxidizing groundwater environments.

2811 (Y/TS–824/R1) **Resource Conservation and Recovery Act (RCRA): Part B permit application for Interim Reactive Waste Treatment Area (IRWTA) at the Oak Ridge Y-12 Plant: Revision 1.** Bostock, D.J. Oak Ridge Y-12 Plant, TN (United States). 24 Aug 1992. 237p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OS21400. Order Number DE92041269. Source: OSTI; NTIS; INIS; GPO Dep.

This report is in response to a notice of deficiency concerning the permit application prepared for the Interim Reactive Waste Treatment Area (IRNWA) located at the Y-12 Plant. This area is utilized for the burning of Sodium Potassium (NaK) generated from a spill during maintenance activities at the Y-12 Plant. As the name implies, this is an interim unit used for treatment of NaK until an alternate method of treatment is developed. It is expected that this alternate unit will be developed by 1995. The unit currently operates in accordance with an Open Burning Permit No. 0100020-00001. The treatment of the NaK waste material consists of the open burning of the material aild disposing of the waste residue in a properly regulated facility. The area is approximately 100 feet by 100 feet of grubbed earth.

0530 Environmental Aspects

Refer also to citation(s) 2660, 2661, 2662, 2663, 2664, 2668, 2670, 2724, 2730, 2733, 2743, 2750, 2760, 2769, 2776, 2830, 2833, 2846, 3090, 3474, 4101, 4181, 4212, 4217, 4220, 4260, 4364, 4367, 4369, 4370

2812 (DOE/EA–0605) **Environmental assessment for the West Office Building, Building 2100 at the Oak Ridge National Laboratory, Oak Ridge, Tennessee.** USDOE, Washington, DC (United States). Sep 1992. 18p. Sponsored by USDOE, Washington, DC (United States). Order Number DE93002208. Source: OSTI; NTIS; GPO Dep.

The Department of Energy has prepared an Environmental Assessment (EA), DOE/EA-0605 for the construction and operation of the proposed West Office Building, Building 2100, to be located at a previously disturbed site inside the security-fenced region of the main Oak Ridge National Laboratory (ORNL) complex in Bethel Valley. The facility will be used to house technical and support personnel of the Laboratory Protection (LP) Division and the Office of Radiation Protection (ORP). Based on the analyses in the EA, DOE has determined that the proposed action is not a major federal action significantly affecting the quality of the human environment within the meaning of the National Environmental Policy Act (NEPA) of 1969. Therefore, the preparation of an environmental impact statement (EIS) is not required, and the Department is issuing this Finding of No Significant Impact (FONSI).

2813 (DOE/NV/10845–15) **Estimates of potential radionuclide migration at the Bullion site.** Brikowski, T.H. Nevada Univ., Reno, NV (United States). Water Resources Center. Apr 1992. 33p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC08-90NV10845. Order Number DE93003157. Source: OSTI; NTIS; INIS; GPO Dep.

The Bullion site in Area 20 of the Nevada Test Site has been selected for an intensive study of the hydrologic consequences of underground testing, including subsequent radionuclide migration. The bulk of the chimney and cavity lie in zeolitized tuffs of low hydraulic conductivity, while the base of the cavity may extend downward into more conductive rhyolite flows. A mathematical analog to the Bullion setting is used here to estimate expected radionuclide migration rates and concentrations. Because of a lack of hydrologic data at the site, two contrasting scenarios are considered. The first is downward-transport, in which downward hydraulic gradients flush chimney contents into the conductive underlying units, enhancing migration. The other is upward-transport, in which upward gradients tend to drive chimney contents into the low-conductivity zeolitized tuffs, discouraging migration. In the downward-transport scenario, radionuclide travel times and concentrations are predicted to be similar to those encountered at Cheshire, requiring approximately 10 years to reach a proposed well 300 m downgradient. The upward transport scenario yields predicted travel times on the order of 2,000 years to the downgradient well. The most likely scenario is a combination of these results, with vertical movement playing a limited role. Radionuclides injected directly into the rhyolites should migrate laterally very quickly, with travel times as in the downward-transport scenario. Those in the zeolitized tuff-walled portion of the chimney should migrate extremely slowly, as in the upward-transport scenario.

2814 (DOE/RL–92-30) **Radionuclide air emissions report for the Hanford Site: Calendar year 1991.** Rokkan, D.J. (Science Applications International Corp., Richland, WA (United States)); Diediker, L.P.; Manley, C.L. Westinghouse Hanford Co., Richland, WA (United States). Jun 1992. 107p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-87RL10930. Order Number DE93001678. Source: OSTI; NTIS; INIS; GPO Dep.

This report documents the radionuclide air emissions from the Hanford Site in 1991 and the resulting effective dose equivalent to any member of the public. The report is submitted in compliance with reporting requirements in the Code of Federal Regulations, Title 40, Protection of the Environment, Part 61, "National Emissions Standards for Hazardous Air Pollutants."

2815 (DOE/RL–92-62) **Executive summary, Hanford Site Pollution Prevention Plan.** USDOE Richland Field Office, WA (United States). Aug 1992. 28p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-87RL10930. Order Number DE93002051. Source: OSTI; NTIS; INIS; GPO Dep.

A pollution prevention plan is an organized, comprehensive, and continual effort to systematically reduce waste generation. The Hanford Site Pollution Prevention Plan is designed to eliminate or minimize pollutant releases to all environmental media from all aspects of Site operations. These efforts offer increased protection of public health and the environment. This plan reflects the goals and policies for pollution prevention at the Hanford Site and represents an ongoing effort to make pollution prevention part of the Site operating philosophy. The plan encompasses hazardous waste only and excludes radioactive waste and radioactive mixed waste.

2816 (DUN–1139) **Contamination control – Columbia River: Monthly report, May 1966.** Geier, R.G. Douglas United Nuclear, Inc., Richland, WA (United States). 3 Jun 1966. 17p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE93000316. Source: OSTI; NTIS (US Sales Only); GPO Dep.

It is the purpose of this report to present data obtained from the routine reactor effluent radioactivity monitoring program as well as the results obtained from the research and development program directed toward the reduction of effluent radioactivity.

2817 (ES/ER/TM–38) **Approach and strategy for developing human health toxicity information for contaminants of concern at sites administered by the US Department of Energy Oak Ridge Field Office, Environmental Restoration Program.** Ross, R.H.; Redfearn, A.; White, R.K.; Shaw, R.A. Oak Ridge National Lab., TN (United States). Oct 1992. 12p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. Order Number DE93001933. Source: OSTI; NTIS; INIS; GPO Dep.

Toxicity assessment is an important part of the risk assessment effort presently under way at US Department of Energy Oak Ridge Field Office (DOE-OR) Environmental Restoration (ER) facilities. Four major tasks in the toxicity assessment process are (1) identification and prioritization of contaminants of concern at DOE-OR ER sites; (2) compilation and dissemination of toxicity values approved by the US Environmental Protection Agency for the contaminants of concern and identification of contaminants requiring toxicity value development (i.e., reference doses, reference concentrations, and slope factors); (3) development of toxicity summaries; and (4) development of toxicity values. Prioritization of chemicals was the lint step because resources are limited and because the chemicals that pose the greatest risk of human exposure need immediate assessment. Identifying and disseminating the toxicity values for the chemicals of concern is also important because these toxicity values are the basis for determining whether environmental levels are of concern. It is very important that all parties conducting health risk assessment for DOE-OR ER sites have the most current toxicity values so that risk assessment will be consistent The toxicity summaries for the chemicals of concern briefly summarize what is known concerning the toxicity of each chemical and present the information in a way that is useful for the risk assessor. After existing toxicity values are located and the toxicity summaries prepared, the chemicals that have sufficient information to derive missing toxicity values can be identified. Where toxicity values are missing and the information is deficient to derive the values by conventional means, predictive toxicology methods will be employed.

2818 (IAEA-TECDOC–650, pp. 232-237) **Environmental issues related to the decommissioning of mine sites and to the rehabilitation of sites of the Wismut Corporation, Germany.** Haehne, R. (SDAG Wismut, Chemnitz (Germany)). International Atomic Energy Agency, Vienna (Austria); Nuclear Energy Agency, 75 - Paris (France). Jun 1992. (CONF-9108224–: Technical committee meeting on new developments in uranium exploration, resources, production and demand, Vienna (Austria), 26-29 Aug 1991). In *New developments in uranium exploration, resources, production and demand: Proceedings of a technical committee meeting held in Vienna, 26-29 August 1991.* 258p. Order Number DE93607128. Source: OSTI; NTIS (US Sales Only); INIS.

The environmental impact of the extensive uranium mining and processing activities of the Wismut Company in Eastern Germany on the biosphere are described. The total area contaminated by these past and present operations is estimated at 1000 km^2, located in the Federal Provinces Saxony, Thuringia and Saxony-Anhalt. In addition to the environmental damages caused by the uranium mining industry there is the impact of the silver mining activities which throughout the Middle Ages were carried out in Erzgebirge. (author).

2819 (KAERI-NEMAC/RR–40/91) **Evaluation of structural behavior, geological and hydrogeological characteristics: Shear behavior of rock joints.** Rhee, Chan Goo (Korea Atomic Energy Research Inst., Daeduk (Korea, Republic of)); Hwang, Shin Il; Lee, Young Up; Hyun, Jae Hyuk; Kim, Ji Young; Chang, Chun Joong; Lee, Jong Uk; Lee, Ji Hoon; Choi, Weon Hack. Korea Atomic Energy Research Inst., Daeduk (Korea, Republic of). Feb 1992. 114p. (In Korean). Order Number DE93607153. Source: OSTI; NTIS (US Sales Only); INIS.

The major goal of this project is to verify the site suitability for radioactive waste disposal as follows : (1) to find the relationship between the characteristics of discontinuities and the mechanical behavior, (2) to derive the mechanical parameters which are applicable to the field from the laboratory shear test, (3) to verify their applicability. Core specimens from Cneiss terrain were tested to examine the shear behavior of joints using a portable direct shear box. Second polynomial equation to reduce the error of joint roughness coefficient values and the relationships between shear strength and characteristic of joint surface were suggested. The characteristics of shear displacement on the joint surface with shear stress, the characteristics of dilation with shear displacement, and the failure characteristics with failure mode were verified. In addition, to evaluate the mechanical parameters that can influence shear stiffness, the shear stiffness of each specimen was obtained, the relationships between normal stress, JRC, and JCS were studied, and some influences with size effect were also studied. (Author).

2820 (NMP-RMT–910319-Rev.1) **Documentation of toxicity testing results on increased supernate treatment rate of 2700 gallons/batch: Revision 1.** Pickett, J.B. Westinghouse Savannah River Co., Aiken, SC (United States). 6 Jul 1992. 10p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC09-89SR18035. Order Number DE93000475. Source: OSTI; NTIS; INIS; GPO Dep.

In February 1991, Reactor Materials increased the rate of supernate treatment in the M-Area Dilute Effluent Treatment Facility (DETF) from 1800 gallons to ~2700 gallons of supernate per 36,000 gallon dilute wastewater batch. The first release of the treated effluent began on March 3, 1991. A series of whole effluent toxicity tests was conducted on the DETF effluent to determine if the increased supernate concentration would result in any chronic toxicity affects in the receiving stream (Tims Branch). The toxicity tests were conducted at instream concentrations equivalent to DETF release rates of 5, 10, 15, 20, and 25 gallons/min. The test results, based on 7-day Ceriodaphnia dubia chronic toxicity, indicated no toxicity effects at any concentration tested. Supernate treatment in DETF continued at the higher concentration.

2821 (NSS-R–176) **Mineralogy and petrography of samples of Permo-Triassic sedimentary strata from Cumbria.** Kemp, S.J. (British Geological Survey, Keyworth (United Kingdom)); Milodowski, A.E.; Bloodworth, A.J. United Kingdom Nirex Ltd., Harwell (United Kingdom). Mar 1989. 37p. Contract UX/96/243. Order Number DE93607966. Source: OSTI; NTIS (US Sales Only); INIS.

The mineralogy and petrography of Permo-Triassic sediments from Cumbria are described. The samples are duplicates of those selected for sorption experiments by Harwell Laboratory and are considered representative of Permo-Triassic strata underlying the BNFL Sellafield site. The regional geological context of the samples is briefly discussed. X-ray diffraction analysis indicates that the St Bees Sandstone and Eden Shales samples are predominantly composed of quartz with minor feldspar, gypsum and hematite. The clay assemblage is formed of dioctahedral mica and trioctahedral chloride with minor kaolinite. Diagnostic testing also reveals the presence of corrensite, a regularly interstratified chlorite-smectite, in one of the samples. Possible diagenetic processes responsible for corrensite formation, including the alteration of originally deposited smectite by magnesium-rich pore waters, are discussed. Modelling of the diffraction profile indicates that the chlorite and corrensite are iron-rich species. Back scattered electron microscopy shows the samples to be typical red bed sediments exhibiting framework grain dissolution, the breakdown and replacement of unstable ferromagnesian minerals being accompanied by the precipitation of hematite and anatase. Particle-size analysis shows similar distributions for the St Bees Sandstone samples but a greater proportion of clay material in the Eden Shales. (author).

2822 (ORNL/TM–11952) **Results of the outdoor radiological survey at the Portsmouth Gaseous Diffusion Plant site, Piketon, Ohio.** Rodriguez, L.M.; Floyd, L.M.; Carrier, R.F. Oak

Ridge National Lab., TN (United States). Sep 1992. 32p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. Order Number DE93002227. Source: OSTI; NTIS; INIS; GPO Dep.

The Portsmouth Gaseous Diffusion Plant (PORTS) is owned by the US Department of Energy (DOE) and managed by Martin Marietta Energy Systems, Inc. As shown in Fig. 1, the plant is located in sparsely populated, rural Pike County, Ohio. PORTS began in 1952 as part of the Atomic Energy Commission's (AEC) proposed expansion of the gaseous diffusion program in order to increase the production of enriched uranium. The 3,708-acre site is about a half mile east of US Interstate 23 (Fig. 2) and approximately 1 mile east of the Scioto River Valley (Fig. 3). The current layout of the plant is shown on Fig. 4. The principal site process is the separation of uranium isotopes ^{235}U and ^{238}U through gaseous diffusion. This uranium enrichment process involves the more rapid diffusion of lighter molecules of UF_6 (uranium hexaflouride) through the barrier walls of a porous tube. The end result is a UF_6 stream that is slightly enriched in the ^{235}U isotope. The separation process is repeated in a cascade arrangement until the desired concentration is reached. At the request of the PORTS Environmental Safety and Health Division, the Health and Safety Research Division (HASRD), Oak Ridge National Laboratory (ORNL), conducted a radiological survey of the outdoor surface environment of the PORTS site. The surveyed area covered approximately 150 acres of fenced ground consisting of dirt, asphalt, and concrete. The survey was performed between July 1990 and April 1991, and the results reported to PORTS, Health Physics Department. The survey purpose was to determine the extent of radiological contamination and to locate and prioritize areas of concern from both a worker health/safety and an environmental standpoint. Specifically, the objectives of the survey were to assess the areal radioactive status of the site and to analyze surface soil samples for the presence of selected radionuclides. The principal radionuclide of concern is uranium.

2823 (PNL-SA-20978) **An evaluation of slug interference tests for aquifer characterization at the Hanford Site.** Spane, F.A. Jr.; Thorne, P.D. Pacific Northwest Lab., Richland, WA (United States). [1992]. 12p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. (CONF-920851–78: Spectrum '92: nuclear and hazardous waste management international topical meeting, Boise, ID (United States), 23-27 Aug 1992). Order Number DE93001308. Source: OSTI; NTIS; INIS; GPO Dep.

Slug interference tests are conducted by instantaneously changing the water level in a well and monitoring the aquifer response at one or more observation wells. The applicability of this method for hydraulic characterization of a high permeability unconfined aquifer at the Hanford Site was evaluated. Analytical techniques were used to predict slug interference responses over a range of aquifer hydraulic conditions and observation well distances. This was followed by a field test of the proposed technique. The results showed that slug interference testing can be used to characterize aquifers having transmissivities up to 10^{-1} m^2/s compared to a maximum transmissivity of about 10^{-3} m^2/s for single-well slug tests. The amplitude of the pressure response measured at the observation well is primarily determined by aquifer storativity, while the time-lag of the pressure peak is mainly controlled by the transmissivity. Several recommendations are made optimizing the results of slug interference tests in higher permeability, unconfined to semiconfined aquifers.

2824 (WHC-EP-0402-Rev.1) **Status of birds at the Hanford Site in southeastern Washington: Revision 1.** Landeen, D.S.; Johnson, A.R.; Mitchell, R.M. Westinghouse Hanford Co., Richland, WA (United States). Jun 1992. 22p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-87RL10930. Order Number DE93002053. Source: OSTI; NTIS; INIS; GPO Dep.

The US Department of Energy has entered into agreements with the Washington State Department of Ecology, the US Environmental Protection Agency, and Hanford Site contractors to focus work activities on cleanup and stabilization of radioactive and hazardous waste sites located at the Hanford Site in southeastern Washington. Ecological characterization is an essential part of the remediation process, and the identification of biotic components such as bird species that could be impacted by cleanup activities is an important part of the initial environmental characterizations. Site characterization work has resulted in this list of 238 birds that have been observed at the Hanford Site. This list is presented with a status rating for abundance and seasonal occurrence.

2825 (WSRC-RP-92-224) **Simulant composition for the Mixed Waste Management Facility (MWMF) groundwater remediation project.** Siler, J.L. Westinghouse Savannah River Co., Aiken, SC (United States). 31 Jan 1992. 5p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC09-89SR18035. Order Number DE93001354. Source: OSTI; NTIS; INIS; GPO Dep.

A project has been initiated at the request of ER to study and remediate the groundwater contamination at the Mixed Waste Management Facility (MWMF). This water contains a wide variety of both inorganics (e.g., sodium) and organics (e.g., benzene, trichloroethylene). Most compounds are present in the ppB range, and certain components (e.g., trichloroethylene, silver) are present at concentrations that exceed the primary drinking water standards (PDWS). These compounds must be reduced to acceptable levels as per RCRA and CERCLA orders. This report gives a listing of the important constituents which are to be included in a simulant to model the MWMF aquifer. This simulant will be used to evaluate the feasibility of various state of the art separation/destruction processes for remediating the aquifer.

0540 Health and Safety

Refer also to citation(s) 2657, 2658, 2659, 2661, 2662, 2664, 2665, 2666, 2667, 2668, 2669, 2671, 2672, 2673, 2674, 2675, 2676, 2677, 2678, 2697, 2700, 2701, 2724, 2740, 2741, 2764, 2766, 2789, 2793, 2794, 2795, 2811, 2814, 2817, 2849, 3156, 3157, 3159, 3161, 3165, 3313, 3470, 3499, 3510, 4185, 4206, 4329, 4331, 4334, 4353, 4427, 4799

2826 (ANL/ESD/TM-33) **Geophysics: Building E5190 decommissioning, Aberdeen Proving Ground: Interim progress report.** Miller, S.F.; Thompson, M.D.; McGinnis, M.G.; McGinnis, L.D. Argonne National Lab., IL (United States). Energy Systems Div. Jul 1992. 33p. Sponsored by Department of Defense, Washington, DC (United States). DOE Contract W-31109-ENG-38. Order Number DE93002852. Source: OSTI; NTIS; GPO Dep.

Building E5190 is one of ten potentially contaminated sites in the Canal Creek area of the Edgewood section of Aberdeen Proving Ground examined by a geophysical team from Argonne National Laboratory in April and May 1992. A noninvasive geophysical survey, including the complementary technologies of magnetics, electrical resistivity, and ground-penetrating radar, was conducted around the perimeter as a guide to developing a sampling and monitoring program prior to decommissioning and dismantling the building. The magnetics surveys indicated that multistation, positive magnetic sources are randomly distributed north and west of the building. Two linear trends were noted: one that may outline buried utility lines and another that is produced by a steel-covered trench. The resistivity profiling indicated three conductive zones: one due to increased moisture in a ditch, one associated with buried utility lines, and a third zone associated with the steel-covered trench. Ground-penetrating radar imaging detected two significant anomalies, which were correlated with small-amplitude magnetic anomalies. The objectives of the study – to detect and locate objects and to characterize a located object were achieved.

2827 (CONF-921029–7) **An integrated performance measure for environmental restoration at Oak Ridge National Laboratory.** Boston, H.L.; Kuhaida, A.J. Jr.; Garland, S.B. Oak Ridge National Lab., TN (United States). [1992]. 7p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. From Annual Department of Energy model conference on waste management and environmental restoration; Oak Ridge, TN (United States); 19-22 Oct 1992. Order Number DE93000438. Source: OSTI; NTIS; INIS; GPO Dep.

A number of contaminated sites at the Oak Ridge National Laboratory (ORNL) require remediation. A strategy has been developed to support the remediation of individual sites, while providing an integrated measure of contaminant release from all sites and serving

as a performance measure for remedial efforts. Most ORNL facilities are in one watershed and groundwater pathways are known to be localized within the watershed. Thus the stream system is the receptor for contaminants released from individual sites and a conduit for contaminant transport off site. Monitoring at key locations in the watershed is linked with information from environmental investigations to: (1) identify and quantify contaminant fluxes; (2) identify the pathways of greatest concern for human health and ecological risk; (3) improve conceptual models of contaminant movement; (4) evaluate remedial alternatives; (5) prioritize sites for remediation; and, (6) document reduced contaminant fluxes following remediation. The contaminants of greatest concern are associated with soil and aquatic sediment. The subjects of investigations range from soil processes and bioindicators of contaminant exposure, to phenomena at the watershed-level such as models predicting contaminant movement during large storms and predicting groundwater transport of contaminants. These efforts provide the foundation needed to coordinate the remediation of individual sites and to assess the overall performance of remedial actions.

2828 (CONF-921029–9) **Unique issues concerning "placement" vs "movement" of contaminated soils at ORNL's CERCLA sites.** Greer, J.K. Jr.; Schrof, C.A. Oak Ridge National Lab., TN (United States). [1992]. 11p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. From Annual Department of Energy model conference on waste management and environmental restoration; Oak Ridge, TN (United States); 19-22 Oct 1992. Order Number DE93001640. Source: OSTI; NTIS; INIS; GPO Dep.

At Oak Ridge National Laboratory, which is owned and operated by the US Department of Energy (DOE), there are several areas where hazardous wastes and/or radioactive materials have been placed in shallow land burial trenches or "auger" holes for disposal. Since Oak Ridge Reservation (ORR) has been placed on the National Priority List (NPL) by the US Environmental Protection Agency (EPA), the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA) applies to waste disposal sites at ORNL. Under CERCLA, the RCRA regulations, pertaining to the LDRs, apply to CERCLA activities if the regulations are deemed "applicable or relevant and appropriate" (ARARS) by the lead agency or by the EPA. This report discusses the following issue: Under what conditions will contaminated soil and debris generated at a Superfund site be subject to the Resource Conservation and Recovery Act (RCRA) land disposal restrictions (LDRs) treatment standards?

2829 (DOE/EW/40017–T3) **Apollo Pennsylvania Nuclear Fuel Facility D&D Project: Quarterly technical progress report, April 1, 1992–June 30, 1992.** Babcock and Wilcox Co., Apollo, PA (United States). [1992]. 23p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG01-91EW40017. Order Number DE93002311. Source: OSTI; NTIS; GPO Dep.

The Apollo Pennsylvania Nuclear Fuel Facility D&D Project involves the site characterization, remediation, decontamination, and deconstruction of a former commercial nuclear fuel manufacturing site. These nuclear fuel manufacturing operations were performed under Nuclear Regulatory Commission License No. SNM-145. The Apollo site is located in an industrial complex in the Borough of Apollo, Pennsylvania. To organize, manage, and control decommissioning activities, the Apollo Nuclear Fuel Facility D&D Project site has been broken down into three areas: the Apollo Facility, the parking lot, and an offsite area. The former fuel manufacturing operations were performed in the Apollo Facility which consisted of the main building (i.e., the east bay) and several attached buildings including the west bay, the box shop, and the annex. These buildings are on B&W owned property and are located on the east side of the site. They consist of approximately one acre of roofed area bounded on the north, south, and west by a metals processing facility located on the offsite property. These two-story buildings housed the former nuclear fuel manufacturing operations, laboratories, and other support operations. During the reporting period, work on the 1992 remediation program continued. Total progress for the 1992 work scope is summarized in Table 1. The table also shows the progress on each of the major decommissioning program sub elements (i.e., characterization, engineering, remediation, site restoration, and site release).

2830 (DOE/OR–1070-D2) **Field Sampling and Analysis Plan for the Remedial Investigation of Waste Area Grouping 2 at Oak Ridge National Laboratory, Oak Ridge, Tennessee: Responses to comments.** Oak Ridge National Lab., TN (United States). Oct 1992. 63p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. (ORNL/ER–58-D2). Order Number DE93001421. Source: OSTI; NTIS; INIS; GPO Dep.

Environmental Sciences Division Publication 3985.

This report provides responses to US Environmental Protection Agency Region IV EPA-M and Tennessee Department of Environment and Conservation Oversite Division (TDEC-O) comments on report ORNL/ER-58, Field Sampling and Analysis Plan for the Remedial Investigation of Waste Area Grouping 2 at Oak Ridge National Laboratory, Oak Ridge, Tennessee. Waste Area Grouping (WAG) 2 consists of the White Oak Creek (WOC) drainage system downgradient of the major ORNL WAGs in the WOC watershed. A strategy for the remedial investigation (RI) of WAG2 was developed in report ES/ER-14&DI, Remedial Investigation Plan for Waste Area Grouping 2 at Oak Ridge National Laboratory, Oak Ridge, Tennessee. This strategy takes full advantage of WAG2's role as an integrator of contaminant releases from the ORNL WAGs in the WOC watershed, and takes full advantage of WAG2's role as a conduit for contaminants from the ORNL site to the Clinch River. The strategy calls for a multimedia environmental monitoring and characterization program to be conducted in WAG2 while upgradient contaminant sources are being remediated. This monitoring and characterization program will (1) identify and quantify contaminant fluxes, (2) identify pathways of greatest concern for human health and environmental risk, (3) improve conceptual models of contaminant movement, (4) support the evaluation of remedial alternatives, (5) support efforts to prioritize sites for remediation, (6) document the reduction in contaminant fluxes following remediation, and (7) support the eventual remediation of WAG2. Following this strategy, WAG2 has been termed an "integrator WAG," and efforts in WAG2 over the short term are directed toward supporting efforts to remediate the contaminant "source WAGS" at ORNL.

2831 (DOE/OR/21548–228-Rev.1) **Quarry Haul Road Ecological Survey: Weldon Spring Site Remedial Action Project, Weldon Spring, Missouri: Revision 1.** MK-Ferguson Co., Weldon Spring, MO (United States); Jacobs Engineering Group, Inc., St. Charles, MO (United States). Sep 1992. 35p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-86OR21548. Order Number DE93001564. Source: OSTI; NTIS; INIS; GPO Dep.

This biological survey was performed to document the summer flora and fauna found along the haul road constructed as part of the remedial action for the quarry bulk waste. State and Federal species listed as threatened or endangered were noted if encountered while surveying. Sampling locations were equally spaced along the quarry haul road, and a survey for vegetation and birds conducted at each location. Bird observations were conducted as breeding bird surveys once in June of 1991, and again in June of 1992. Each year's survey includes two observations in the early morning and one late in the evening. Vegetation surveys were conducted in 1991 using quadrants and transects. mammal, reptile, and amphibian sightings were noted as encountered.

2832 (DOE/OR/21949–340) **Hazelwood Interim Storage Site annual environmental report for calendar year 1991, Hazelwood, Missouri.** Bechtel National, Inc., Oak Ridge, TN (United States). Sep 1992. 155p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-91OR21949. Order Number DE93001266. Source: OSTI; NTIS; INIS; GPO Dep.

This document describes the environmental monitoring program at the Hazelwood Interim Storage Site (HISS) and surrounding area, implementation of the program, and monitoring results for 1991. Environmental monitoring of HISS began in 1984 when the site was assigned to the US Department of Energy (DOE) as part of the decontamination research and development project authorized by Congress under the 1984 Energy and Water Development

Appropriations Act. DOE placed responsibility for HISS under the Formerly Utilized Sites Remedial Action Program (FUSRAP), a DOE program to decontaminate or otherwise control sites where residual radioactive materials remain from the early years of the nation's atomic energy program or from commercial operations causing conditions that Congress has authorized DOE to remedy. The environmental monitoring program at HISS includes sampling networks for radon concentrations in air; external gamma radiation exposure; and radium-226, thorium-230, and total uranium concentrations in surface water, sediment, and groundwater. Additionally, several nonradiological parameters are measured in groundwater. Monitoring results are compared with applicable Environmental Protection Agency standards, DOE derived concentration guides (DCGs), dose limits, and other requirements in DOE orders. Environmental standards and DCGs are established to protect public health and the environment.

2833 (DOE/OR/21949–342) **Middlesex Sampling Plant annual environmental report for calendar year 1991, Middlesex, New Jersey: Formerly Utilized Sites Remedial Action Program (FUSRAP).** Bechtel National, Inc., Oak Ridge, TN (United States). Sep 1992. 153p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-91OR21949. Order Number DE93001268. Source: OSTI; NTIS; INIS; GPO Dep.

This document describes the environmental monitoring program at the-Middlesex Sampling Plant (MSP) and surrounding area, implementation of the program, and monitoring results for 1991. Environmental monitoring of MSP began in 1980 when Congress added the site to the US Department of Energy's (DOE) Formerly Utilized Sites Remedial Action Program (FUSRAP). FUSRAP is a DOE program to decontaminate or otherwise control sites where residual radioactive materials remain from the early years of the nation's atomic energy program or from commercial operations causing conditions that Congress has authorized DOE to remedy. The environmental monitoring program at MSP includes sampling networks for radon and thoron concentrations in air; external gamma radiation exposure; and radium-226, thorium-232, and total uranium concentrations in surface water, sediment,, and groundwater. Additionally, several nonradiological parameters are measured in groundwater, surface water, and sediment. Results of environmental monitoring during 1991 indicate that most concentrations were well below applicable guidelines. The potential radiation dose calculated for a hypothetical maximally exposed individual, based on a conservative but realistic exposure scenario, is 2.3 mrem (milliroentgen equivalent man) per year, which is less than an individual would receive while traveling in an airplane at 12,000 meters for five hours. During 1991, there were no nonroutine releases from the site; MSP was in compliance with applicable regulations for releases from the site. Site activities included environmental monitoring, site maintenance, onsite characterization for the MSP remedial investigation, and additional sediment sampling at the plant outfall to determine the source of the elevated levels of radium-226 and thorium-232.

2834 (DOE/OR/21949–343) **Niagara Falls Storage Site annual environmental report for calendar year 1991, Lewiston, New York.** Bechtel National, Inc., Oak Ridge, TN (United States). Sep 1992. 186p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-91OR21949. Order Number DE93001262. Source: OSTI; NTIS; INIS; GPO Dep.

This document describes the environmental monitoring program at the Niagara Falls Storage Site (NFSS) and surrounding area, implementation of the program, and monitoring results for 1991. Environmental monitoring at NFSS began in 1981. The site is owned by the US Department of Energy (DOE) and is assigned to the DOE Formerly Utilized Sites Remedial Action Program (FUSRAP). FUSRAP is a program to decontaminate or otherwise control sites where residual radioactive materials remain from the early years of the nation's atomic energy program or from commercial operations causing conditions that Congress has authorized DOE to remedy. The environmental monitoring program at NFSS includes sampling networks for radon concentrations in air; external gamma radiation exposure; and total uranium and radium-226 concentrations in surface water, sediments, and groundwater. Additionally, several nonradiological parameters including seven metals are routinely measured in groundwater. Monitoring results are compared with applicable Environmental Protection Agency (EPA) standards, DOE derived concentration guides (DCGs), dose limits, and other requirements in DOE orders. Environmental standards are established to protect public health and the environment.

2835 (DOE/OR/21949–344) **Maywood Interim Storage Site annual environmental report for calendar year 1991, Maywood, New Jersey: Formerly Utilized Sites Remedial Action Program (FUSRAP).** Bechtel National, Inc., Oak Ridge, TN (United States). Sep 1992. 189p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-91OR21949. Order Number DE93001263. Source: OSTI; NTIS; INIS; GPO Dep.

This document describes the environmental monitoring program at the Maywood Interim Storage Site (MISS) and surrounding area, implementation of the program, and monitoring results for 1991. Environmental monitoring of MISS began in 1984 when congress added the site to the US Department of Energy's (DOE) Formerly Utilized Sites Remedial Action Program (FUSRAP). FUSRAP is a DOE program to identify and decontaminate or otherwise control sites where residual radioactive materials remain from the early years of the nation's atomic energy program or from commercial operations causing conditions that Congress has authorized DOE to remedy. The environmental monitoring program at MISS includes sampling networks for radon and thoron concentrations in air; external gamma radiation-exposure; and total uranium, radium-226, radium-228, thorium-232, and thorium-230 concentrations in surface water, sediment, and groundwater. Additionally, several nonradiological parameters are measured in surface water, sediment, and groundwater. Monitoring results are compared with applicable Environmental Protection Agency standards, DOE derived concentration guides (DCGs), dose limits, and other requirements in DOE orders. Environmental standards are established to protect public health and the environment.

2836 (DOE/OR/21949–345) **Wayne Interim Storage Site annual environmental report for calendar year 1991, Wayne, New Jersey: Formerly Utilized Sites Remedial Action Program (FUSRAP).** Bechtel National, Inc., Oak Ridge, TN (United States). Sep 1992. 153p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-91OR21949. Order Number DE93001264. Source: OSTI; NTIS; INIS; GPO Dep.

This document describes the envirormental monitoring program at the Wayne Interim Storage Site (WISS) and surrounding area, implementation of the program, and monitoring results for 1991. Environmental monitoring of WISS and surrounding area began in 1984 when Congress added the site to the US Department of Energy's (DOE) Formerly Utilized Sites Remedial Action Program (FUSRAP). FUSRAP is a DOE program to decontaminate or otherwise control sites where residual radioactive materials remain from the early years of the nation's atomic energy program or from commercial operations causing conditions that Congress has authorized DOE to remedy. WISS is a National Priorities List site. The environmental monitoring program at WISS includes sampling networks for radon and thoron concentrations in air; external gamma radiation exposure; and radium-226, radium-228, thorium-232, and total uranium concentrations in surface water, sediment, and groundwater. Several nonradiological parameters are also measured in groundwater. Monitoring results are compared with applicable Environmental Protection Agency standards, DOE derived concentration guides, dose limits, and other requirements in DOE orders. Environmental standards are established to protect public health and the environment.

2837 (DOE/OR/21949–346) **New Brunswick Site annual environmental report for calendar year 1991, New Brunswick, New Jersey: Formerly Utilized Sites Remedial Action Program (FUSRAP).** Bechtel National, Inc., Oak Ridge, TN (United States). Sep 1992. 130p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-91OR21949. Order Number DE93001265. Source: OSTI; NTIS; INIS; GPO Dep.

This document describes the environmental monitoring program at the New Brunswick Site (NBS) and surrounding area, implementation of the program, and monitoring results for 1991. The site, near New Brunswick,, New Jersey, is a 5.6-acre vacant, fenced, and grass-covered area. Environmental monitoring of NBS began

in 1981 when the site was part of the US Department of Energy's (DOE) Surplus Facilities Management Program. In 1990 responsibility for NBS was transferred to the Formerly Utilized Sites Remedial Action Program (FUSP.4P). FUSRAP is a DOE program to identify and decontaminate or otherwise control sites where residual radioactive materials remain from the,early years of the nation's atomic energy program or from commercial operations causing conditions that Congress has authorized DOE to remedy. The environmental monitoring program at NBS includes sampling networks for radon and thoron in air; external gamma radiation exposure; and radium-226, radium-228, thorium-228, thorium-230, thorium-232, americium-241, cesium-137, plutonium-239, and total uranium in surface water, sediment, and groundwater. Several nonradiological parameters are also measured in groundwater, surface water, and sediments. Monitoring results are compared with applicable Environmental Protection Agency standards, DOE derived concentration guides, dose limits, and other requirements in DOE orders. Environmental standards are established to protect public health and the environment.

2838 (DOE/RL–89-09) **RCRA facility investigation/corrective measures study work plan for the 100-DR-1 operable unit, Hanford Site, Richland, Washington.** USDOE Richland Field Office, WA (United States). Sep 1992. 308p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-87RL10930. Order Number DE93002054. Source: OSTI; NTIS; INIS; GPO Dep.

Four areas of the Hanford Site (the 100, 200, 300, and 1100 Areas) have been included on the US Environmental Protection Agency's (EPA's) National Priorities List (NPL) under the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA). Under the Hanford Federal Facility Agreement and Consent Order (Tri-Party Agreement, Ecology et. al. 1990a), signed by the Washington State Department of Ecology (Ecology), EPA, and the US Department of Energy (DOE), more than 1,000 inactive waste disposal and unplanned release sites on the Hanford Site have been grouped into a number of source and groundwater operable units. These operable units contain contamination in the form of hazardous waste, radioactive/hazardous mixed waste, and other CERCLA hazardous substances. Also included in the Tri-Party Agreement are 55 Resource Conservation and Recovery Act (RCRA) treatment, storage, or disposal (TSD) facilities that will be closed or permitted to operate in accordance with RCRA regulations. Some of the TSD facilities are included in the operable units. This work plan and the attached supporting project plans establish the operable unit setting and the objectives, procedures, tasks, and schedule for conducting the RCRA facility investigation/corrective measures study (RFI/CMS) for the 100-DR-1 source operable unit Source operable units include facilities and unplanned release sites that are potential sources of contamination.

2839 (DOE/RL–90-20) **Remedial investigation/feasibility study work plan for the 100-KR-1 operable unit, Hanford Site, Richland, Washington.** USDOE Richland Operations Office, WA (United States). Jul 1992. 314p. Sponsored by USDOE, Washington, DC (United States). Order Number DE93002197. Source: OSTI; NTIS; INIS; GPO Dep.

Four areas of the Hanford Site (the 100, 200, 300, and 1100 Areas) have been included on the US Environmental Protection Agency's (EPA's) National Priorities List (NPL) under the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA). Figure 1-1 shows the location of these areas. Under the Hanford Federal Facility Agreement and Consent Order (Tri-Party Agreement, Ecology et al. 1990a), signed by the Washington State Department of Ecology (Ecology), EPA, and the US Department of Energy (DOE), more than 1,000 inactive waste disposal and unplanned release sites on the Hanford Site have been grouped into a number of source and groundwater operable units. These operable units contain contamination in the form of hazardous waste, radioactive/hazardous mixed waste, and other CERCLA hazardous substances. Also included in the Tri-Party Agreement are 55 Resource Conservation and Recovery Act (RCRA) treatment, storage, or disposal (TSD) facilities that will be closed or permitted to operate in accordance with RCRA regulations, under the authority of Chapter 173-303 Washington Administrative Code (WAC). Some of the TSD facilities are included in the operable units. This work plan and the attached supporting project plans establish the objectives, procedures, tasks, and schedule for conducting the CERCLA remedial investigation/feasibility study (RI/FS) for the 100-KR-1 operable unit. The 100-KR-1 source operable unit is one of three source operable units in the 100-K Area. Source operable units include facilities and unplanned release sites that are potential sources of hazardous substance contamination.

2840 (ES/ER/TM–4/R2) **Environmental Restoration Quality Program Plan: Environmental Restoration Program.** Colley, J.S. Oak Ridge National Lab., TN (United States). Aug 1992. 44p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. Order Number DE92040849. Source: OSTI; NTIS; GPO Dep.

The Martin Marietta Energy Systems, Inc., Environmental Restoration (ER) Program was initially chartered on October 1, 1989, as a "entral Environmental Restoration Division" to manage the investigation and remediation of inactive sites and facilities that have been declared surplus and have no further programmatic use. The Energy Systems ER Division was established to support the DOE Oak Ridge Field Office (DOE-OR) consolidated ER Program. The DOE-OR Assistant Manager for Environmental Restoration and Waste Management provides program and budget direction to the Energy Systems ER Program for environmental restoration activities at the sites operated by Energy Systems (Oak Ridge K-25 Site, Oak Ridge National Laboratory, Oak Ridge Y-12 Plant, Paducah Gaseous Diffusion Plant, Portsmouth Gaseous Diffusion Plant) and at the off-site locations. The Energy Systems ER Division is specifically charged with assessing these sites for potential contamination and managing the cleanup processes. The Energy Systems Environmental Restoration Division was chartered on October 1, 1989, as a central organization to manage the Remedial Action (RA) Program. The purpose of this document is to ensure that: senior ER management provides planning, organization, direction, control, and support to achieve the organization's objectives; the line organization achieves quality; and overall performance is reviewed and evaluated using a rigorous assessment process.

2841 (ES/ER/TM–42) **Environmental Restoration Quality Program Implementation Plan: Environmental Restoration Program.** Oak Ridge National Lab., TN (United States). Aug 1992. 7p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. Order Number DE92041015. Source: OSTI; NTIS; GPO Dep.

The Environmental Restoration (ER) Program requirements for implementation of DOE Order 5700.6C are identified in the Environmental Restoration Quality Program Plan, (QPP). Management systems necessary to implement the ER QPP consist of the necessary standards and procedures required to be developed to adequately control ER processes. To the extent possible, Martin Marietta Energy Systems, Inc., standards and procedures will be utilized at the ER Program level, and requirements will not be repeated. The quality management systems identified for enhancement or development are identified in the section on Procedure Development Strategy and directly relate to unique ER Program activities. Procedures and standards that currently exist in the ER Program will be validated for compliance with ER QPP requirements.

2842 (HW–12863) **H. W. Laboratory manual: 100 Area section.** Hanford Works, Richland, WA (United States). 1 Jul 1950. 476p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE93002580. Source: OSTI; NTIS (US Sales Only); GPO Dep.

The purpose of this manual is to present a Hazard Breakdown of all jobs normally encountered in the laboratory work of the three sections comprising the Analytic Section, Metallurgy and Control Division of the Technical Department. A Hazard Breakdown is a careful analysis of any job in which the source of possible dangers is clearly indicated for each particular step. The analysis is prepared by individuals who are thoroughly familiar with the specific job or procedure. It is felt that if the hazards herein outlined are recognized by the Laboratory personnel and the suggested safety cautions followed, the chance for injury will be minimized and the

worker will become generally more safety conscious. The manual, which is prefaced by the general safety rules applying to all the laboratories, is divided into three main sections, one for each of the three sections into which the Laboratories Division is divided. These sections are as follows: Section 1 – 200 Area Control; Section 2 – 100 Area Control; Section 3 – 300 Area Control, Essential Materials, and Methods Improvement.

2843 (ORNL–6605) **Health and Safety Procedures Manual for hazardous waste sites.** Thate, J.E. Oak Ridge National Lab., Grand Junction, CO (United States). Sep 1992. 284p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. Order Number DE93000494. Source: OSTI; NTIS; GPO Dep.

The Oak Ridge National Laboratory Chemical Assessments Team (ORNL/CAT) has developed this Health and Safety Procedures Manual for the guidance, instruction, and protection of ORNL/CAT personnel expected to be involved in hazardous waste site assessments and remedial actions. This manual addresses general and site-specific concerns for protecting personnel, the general public, and the environment from any possible hazardous exposures. The components of this manual include: medical surveillance, guidance for determination and monitoring of hazards, personnel and training requirements, protective clothing and equipment requirements, procedures for controlling work functions, procedures for handling emergency response situations, decontamination procedures for personnel and equipment, associated legal requirements, and safe drilling practices.

2844 (PNL–8361) **Pacific Northwest Laboratory ALARA report for CY 1991.** Ceffalo, G.M. Pacific Northwest Lab., Richland, WA (United States). Sep 1992. 29p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE93002511. Source: OSTI; NTIS; GPO Dep.

This report provides summary results of the CY 1991 As Low As Reasonably Achievable (ALARA) Program at the Pacific Northwest Laboratory (PNL).(a) This report includes information regarding whole-body exposures to radiation, skin contaminations, and the nonradiological ALARA program.

2845 (PNL–8374) **Evaluation of S-101 course "Supervisors' Orientation to Occupational Safety in DOE" taught in Idaho Falls, Idaho, June 23, 1992–June 26, 1992.** Wright, T.S. Pacific Northwest Lab., Richland, WA (United States). Oct 1992. 19p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE93002975. Source: OSTI; NTIS; GPO Dep.

This report summarizes trainee evaluations for the Safety Training Section course, "Supervisors' Orientation to Occupational Safety in DOE", (S-101) which was conducted June 23—26 at Idaho Falls Engineering Laboratory, in Idaho Falls, Idaho. Section 1.1 and 1.2 of this report summarizes the quantitative course evaluations that trainees provided upon completion of the course. Appendix A provides a transcript of the trainees' written comments. Numeric course ratings were generally positive and show that the course material and instruction were very effective. Written comments supported the positive numeric ratings. The course content and knowledge gained by the trainees exceeded most of the students' expectations of the course.

2846 (PNL-SA–20623) **Kinetics of in situ bioremediation of Hanford groundwater.** Skeen, R.S. (Pacific Northwest Lab., Richland, WA (United States)); Cote, S.M.; Truex, M.J.; Petersen, J.N. Pacific Northwest Lab., Richland, WA (United States). Apr 1992. 12p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. (CONF-920851–82: Spectrum '92: nuclear and hazardous waste management international topical meeting, Boise, ID (United States), 23-27 Aug 1992). Order Number DE93001380. Source: OSTI; NTIS; INIS; GPO Dep.

Liquid wastes containing radioactive, hazardous, and regulated chemicals have been generated throughout the 40+ years of operations at the US Department of Energy's (DOE) Hanford Site. Some of these wastes were discharged to the soil column and many of the waste components, including nitrate, carbon tetrachloride (CCl_4), and several radionuclides, have been detected in the Hanford groundwater. Current DOE policy prohibits the disposal of contaminated liquids directly to the environment, and may require the remediation of existing contaminated groundwaters. In situ bioremediation is one technology currently being developed at Hanford to meet the need for cost effective technologies to clean groundwater contaminated with CCl_4, nitrate, and other organic and inorganic contaminants. This paper focuses on the latest results of an on-going effort to quantify the biological and chemical reactions that would occur during in situ bioremediation.

2847 (WSRC-MS–92-315) **Environmental Restoration Program Control Management System.** Duke, R.T. Westinghouse Savannah River Co., Aiken, SC (United States). 13 Aug 1992. 12p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC09-89SR18035. (CONF-920988–1: 19. annual National Energy and Environmental Quality Division of the American Society for Quality Control (ASQC)conference, Lake Buena Vista, FL (United States), 20-23 Sep 1992). Order Number DE93000469. Source: OSTI; NTIS; INIS; GPO Dep.

Environmental Restoration managers need to demonstrate that their programs are under control. Unlike most industrial programs, the public is heavily involved in Environmental Restoration activities. The public is demanding that the country prove that real progress is being made towards cleaning up the environment. A Program Control Management System can fill this need. It provides a structure for planning, work authorization, data accumulation, data analysis and change control. But it takes time to implement a control system and the public is losing its patience. This paper describes critical items essential to the quick development and implementation of a successful control system.

0550 Safeguards, Inspection, and Accountability

Refer also to citation(s) 3294, 3495, 4060, 4802, 4823

2848 (INIS-mf–13373) **Report of the LASCAR forum: Large scale reprocessing plant safeguards.** International Atomic Energy Agency, Vienna (Austria). 1992. 22p. Order Number DE93608119. Source: OSTI; NTIS (US Sales Only); INIS.

This report has been prepared to provide information on the studies which were carried out from 1988 to 1992 under the auspices of the multinational forum known as Large Scale Reprocessing Plant Safeguards (LASCAR) on safeguards for four large scale reprocessing plants operated or planned to be operated in the 1990s. The report summarizes all of the essential results of these studies. The participants in LASCAR were from France, Germany, Japan, the United Kingdom, the United States of America, the Commission of the European Communities - Euratom, and the International Atomic Energy Agency.

2849 (LA–12386-M) **Nuclear criticality safety: 2-day training course: Offered at The Los Alamos National Laboratory.** Schlesser, J.A. (ed.). Los Alamos National Lab., NM (United States). Nov 1992. 131p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. Order Number DE93003340. Source: OSTI; NTIS; INIS; GPO Dep.

This compilation of notes is presented as a source reference for the criticality safety course. At the completion of this training course, the attendee will: (1) be able to define terms commonly used in nuclear criticality safety; (2) be able to appreciate the fundamentals of nuclear criticality safety; (3) be able to identify factors which affect nuclear criticality safety; (4) be able to identify examples of criticality controls as used at Los Alamos; (5) be able to identify examples of circumstances present during criticality accidents; (6) have participated in conducting two critical experiments.

2850 (SAND–92-1947) **The Remote Security Station (RSS) final report.** Pletta, J.B.; Amai, W.A.; Klarer, P.; Frank, D.; Carlson, J.; Byrne, R. Sandia National Labs., Albuquerque, NM (United States). Oct 1992. 222p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-76DP00789. Order Number DE93003225. Source: OSTI; NTIS; INIS; GPO Dep.

The Remote Security Station (RSS) was developed by Sandia National Laboratories for the Defense Nuclear Agency to investigate issues pertaining to robotics and sensor fusion in physical security systems. This final report documents the status of the RSS program at its completion in April 1992. The RSS system consists

of the Man Portable Security Station (MaPSS) and the Telemanaged Mobile Security Station (TMSS), which are integrated by the Operator's Control Unit (OCU) into a flexible exterior perimeter security system. The RSS system uses optical, infrared, microwave, and acoustic intrusion detection sensors in conjunction with sensor fusion techniques to increase the probability of detection and to decrease the nuisance alarm rate of the system. Major improvements to the system developed during the final year are an autonomous patrol capability, which allows TMSS to execute security patrols with limited operator interaction, and a neural network approach to sensor fusion, which significantly improves the system's ability to filter out nuisance alarms due to adverse weather conditions.

2851 (WHC-SA–1466) **An approach to documenting vulnerability assessments.** Scott, D.D. (Westinghouse Hanford Co., Richland, WA (United States)); Billings, M.P.; Udell, C.J.; Rancher, C.W. Westinghouse Hanford Co., Richland, WA (United States). Jul 1992. 7p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-87RL10930. (CONF-9207102–70: Institute of Nuclear Materials Management (INMM) annual meeting, Orlando, FL (United States), 19-22 Jul 1992). Order Number DE93001424. Source: OSTI; NTIS (US Sales Only); GPO Dep.

For the past several years, significant effort has been expended by the US Department of Energy (DOE) and its contractors to prepare Site Safeguards and Security Plans (SSSP) and Master Safeguards and Security Agreements (MSSA). The analytical process called vulnerability assessment (VA) is fundamental to the development of these documents. To provide credibility among contractor, DOE Field Office, and DOE-Headquarters (DOE-HQ) staff, the VA process and its associated documentation must be formal and structured. Because VA guidance materials and training opportunities have been minimal, site contractors have designed and implemented VAs according to their local interpretations of needs. As a result, VAs have been noticeably lacking in formality and uniformity. The DOE, Albuquerque Field Office, has developed an annotated VA outline for use by its contractors. This outline will (1) promote consistency in VA scope, performance, and reporting and (2) provide a complete, more traceable basis for SSSPs and MSSAs when they are validated by the Field Office and verified by DOE-HQ. This annotated outline suggests form and content for text, tables, and figures for VAs associated with a broad range of facility types and functions.

0560 Legislation and Regulations

Refer also to citation(s) 2698, 2699, 2705, 3035, 3278

2852 (KAERI-NEMAC/RR–29/91) **Study on the establishment of technical standards of radioactive wastes.** Kwon, H.K.; Lee, C.K.; Kang, B.M.; Park, J.M.; Kim, C.S.; Han, P.S.; Han, K.W.; Lee, M.C.; Sim, J.K.; Joun, G.S. Korea Atomic Energy Research Inst., Daeduk (Korea, Republic of). Jan 1992. 146p. (In Korean). Order Number DE93608104. Source: OSTI; NTIS (US Sales Only); INIS.

In order to secure the safety and to assure timely execution of the radwaste management project, NEMAC through the contract with KINS has performed the third period study on the establishment of technical standards related to the low and intermediate level radioactive waste disposal facility and the spent nuclear fuel interim storage facility from march 28, 1991 to January 27, 1992. The details done during this period are as follows ; 1. Low and Intermediate Level Radioactive Wastes : SAR, QA Criteria, Performance Criteria, Siting Criteria, ER, Safety Facility Criteria and SCR 2. Spent Nuclear Fuel Interim Storage Facility : SAR, QA Criteria, Acceptance Criteria, Performance Criteria and Structural Criteria. (Author).

2853 (KAERI-NEMAC/RR–30/91) **Development of cask and transportation system: Installation and test operation of UF_4 pilot plant.** Do, Jae Bum (Korea Atomic Energy Research Inst., Daeduk (Korea, Republic of)); Seo, Chung Seok; Kim, Ik Soo; Oh, Seung Chul; Hong, Sun Seok. Korea Atomic Energy Research Inst., Daeduk (Korea, Republic of). Feb 1992. 100p. (In Korean). Order Number DE93608105. Source: OSTI; NTIS (US Sales Only); INIS.

The purpose of this project is to develop the technology of UF_4 production from depleted UF_6, in order to utilize it as a raw material for the production of depleted uranium (DU) metal. The DU metal is to be used as a shielding material for the manufacturing of the large spent fuel cask, which is to be developed in the near future. The process is that the depleted UF_6 is reduced to UF_4, with hydrogen in a vertical pipe reactor. The pilot plant(30kg-U/hr) for UF_4 production was installed and test operation was conducted. The produced UF_4 was of good color, of fine particle size (5-10 μm), of high purity (>98 5UE.), and had high tap density (3.7-4.3 g/cm^3). (Author).

07 ISOTOPE AND RADIATION SOURCE TECHNOLOGY

0702 Radiation Sources

Refer also to citation(s) 3567, 3644, 3767, 3898, 4787

2854 (AECS-A/FRSR–57) **The effect of gamma irradiation on crude fibre NDF, ADF, and ADL of some Syrian agricultural residues.** Al-Masri, M.R. (Atomic Energy Commission, Damascus (Syrian Arab Republic)); Zarkawi, M. Atomic Energy Commission, Damascus (Syrian Arab Republic). Jul 1992. 17p. (In Arabic). Order Number DE93607557. Source: OSTI; NTIS (US Sales Only); INIS.

The effects of 150 KGy of gamma irradiation on crude fibre and its main components (cellulose, hemicellulose-cellulose and lignin) and on neutral detergent fibre (NDF), acid detergent lignin (ADL), and acid detergent fibre (ADF) were investigated. The results indicate that gamma irradiation decreased Cf content by 30%, 28%, 29%, and 17% for cottonwood, lentils straw, apple-tree pruning products and olive-oil cake, respectively. NDF values also decreased by 5%, 23%, 13% and 3% for, cottonwood, lentils straw, olive-oil cake and apple-tree pruning products respectively. Gamma irradiation (150 KGy) had no effects on ADF and ADL for lentils straw, apple-tree pruning products and olive-oil cake whereas, ADF decreased by 8.5% and ADL by 8.3 for cottonwood. Hemicellulose content increased by 12% for cottonwood while decreased by 54% for lentils straw and by 33% for apple-tree pruning products with no effects for olive-oil cake. Cellulose content decreased by 8.6% for cottonwood whereas no effects for the remaining residues were seen. Gamma irradiation treatment improved the nutritive value of the agriculture residues examined. The reduction in crude fibre content varies with the residue. (author). 15 refs., 5 tabs.

2855 (INIS-mf–13375, pp. 6) **Generating and using reactor reference radiation fields.** Fabry, A. (Reactor Physics Dept., SCK/CEN, Mole (Belgium)). Tajoura Nuclear Research Centre, Tripoli (Libyan Arab Jamahiriya). 1984. 82p. (CONF-8409421–: Seminar on the use of research reactors in fundamental and applied sciences, Tajoura (Libyan Arab Jamahiriya), 16 Sep 1984). In *Seminar on the use of research reactors in fundamental and applied sciences. Programme and abstracts.* Order Number DE93606515. Source: Also available from Tajoura Nuclear Research Centre, Tajoura/Tripoli, Libya.

Short communication. FISSION SPECTRA/calibration standards; GAMMA RADIATION/calibration standards; RESEARCH REACTORS

2856 (INIS-mf–13375, pp. 38) **Development of methods for the determination of β- and α-radiation activity in thick samples.** Barbouti, A.I.; Komarov, N.A.; Aburamadan, U. Tajoura Nuclear Research Centre, Tripoli (Libyan Arab Jamahiriya). 1984. 82p. (CONF-8409421–: Seminar on the use of research reactors in fundamental and applied sciences, Tajoura (Libyan Arab Jamahiriya), 16 Sep 1984). In *Seminar on the use of research reactors in fundamental and applied sciences. Programme and abstracts.* Order Number DE93606515. Source: Also available from Tajoura Nuclear Research Centre, Tajoura/Tripoli, Libya.

Short communication. ALPHA SOURCES/radioactivity; BETA SOURCES/radioactivity; ALPHA PARTICLES; RADIOACTIVITY; BETA PARTICLES

2857 (KAERI/RR–1049/91) **Development of ion implanter and implantation technology for industrial uses.** Choi, Byung Ho (Korea Atomic Energy Research Inst., Daeduk (Korea, Republic of)); Hwang, Churl Kew; Kim, Wan; Jin, Jung Tae; Chung, Kie Suk; Youn, Byeong Joo; Yoon, Jae Sung; Yoo, Han Jong. Korea Atomic Energy Research Inst., Daeduk (Korea, Republic of). Jan 1992. 233p. (In Korean). Order Number DE93605710. Source: OSTI; NTIS (US Sales Only); INIS.

Under the joint work with the MIRAE Co., we have proceeded a commercialization program of the ion implantation technology for surface modification program of materials which had been developed at KAERI Ion Implanter for industrial uses has been developed with the features of high ion current, maximized ion beam utilization and versatility of the irradiation treatment to reduce the process costs under the economic consideration. At 100keV of acceleration energy, nitrogen ion current of 50mA and argon ion current of 30mA were obtained. The target system was maximized for the ion beam utilization and applicability of industrial components with various shapes. The test results of implantation effects on the basic engineering materials as SKD-11 steel, AISI4140 steel, etc, showed improvements of hardness, wear resistance and surface roughness industrial components such as punch, PCB drills, bearings and super-hard tools required for the precision surface treatment acquired 2 to 3 times larger durabilities than those non-treated ones. Domestic market survey revealed that the technology could be applied to some precision mechanical components such as punches, dies, bearings and WC tools which volumes could amount to about 100 billion won/year. (Author).

0703 Isotopic Power Supplies

Refer also to citation(s) 3610

2858 (CONF-930103–2) **Improvements in manufacture of iridium alloy materials.** Ohriner, E.K. Oak Ridge National Lab., TN (United States). [1992]. 6p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. From 10. symposium on space nuclear power and propulsion; Albuquerque, NM (United States); 10-14 Jan 1993. Order Number DE92017126. Source: OSTI; NTIS; INIS; GPO Dep.

Iridium alloys are used as fuel-cladding material in radioisotope thermoelectric generators (RTGs). Hardware produced at the Oak Ridge National Laboratory (ORNL) has been used in Voyager 1 and 2, Galileo, and Ulysses spacecraft. This hardware was fabricated from small, 500-g drop-cast ingots. Porosity in these ingots and the resulting defects in the rolled sheets caused rejection of about 30% of the product. An improved manufacturing process was developed with the goal of substantially reducing the level of defects in the rolled sheets. The ingot size is increased to 10 kg and is produced by vacuum arc remelting. In addition, the ingot is hot extruded prior to rolling. Since implementation of the process in 1989, the average rate of rejection of the product has been reduced to below 10%.

08 HYDROGEN

0801 Production

Refer also to citation(s) 3828

2859 (CONF-910550–, pp. 459-466) **Immobilized cells of a unicellular green alga and a photosynthetic bacterium for use in a biophotolysis system.** Miyamoto, K. (Osaka Univ., Suita, Osaka (Japan)); Matsuoka, S.; Miura, Y.; Negoro, M. National Renewable Energy Lab., Golden, CO (United States); Oak Ridge National Lab., TN (United States). 1992. From 13. symposium on biotechnology for fuels and chemicals; Colorado Springs, CO (United States); 6-10 May 1991. In *Thirteenth symposium on biotechnology for fuels and chemicals: Proceedings.* 846p. Source: The Humana Press, Inc., Totowa, NJ 07511 (United States).

Immobilization of algal and bacterial cells was investigated, and found applicable to a hydrogen production system. Both a unicellular green alga, Chlamydomonas reinhardtii, and a photosynthetic bacterium, Rhodospirillum rubrum, were separately entrapped in calcium alginate gel. The photosynthetic starch accumulation and subsequent dark fermentation of C. reinhardtii were not affected by cell immobilization in Ca-alginate gel. Immobilized cells of R. rubrum retained their ability to utilize various electron donors for hydrogen evolution. Immobilized R. rubrum was stable, at least for a week, in a light and dark cycle. These and other observations suggest that the immobilization of cells could facilitate the broth-recycle between an algal culture system and a bacterial hydrogen production unit.

2860 (CONF-910550–, pp. 613-624) **Mass-transfer and kinetic aspects in continuous bioreactors using Rhodospirillum rubrum.** Cowger, J.P. (Univ. of Arkansas, Fayetteville (United States)); Klasson, K.T.; Ackerson, M.D.; Clausen, E.C.; Gaddy, J.L. National Renewable Energy Lab., Golden, CO (United States); Oak Ridge National Lab., TN (United States). 1992. DOE Contract AC21-86MC23281. From 13. symposium on biotechnology for fuels and chemicals; Colorado Springs, CO (United States); 6-10 May 1991. In *Thirteenth symposium on biotechnology for fuels and chemicals: Proceedings.* 846p. Source: The Humana Press, Inc., Totowa, NJ 07511 (United States).

In designing bioreactors for the conversion of sparingly soluble gases, both mass transfer and kinetic effects must be considered. Rhodospirillum rubrum, an anaerobic photosynthetic bacterium capable of carrying out the water gas shift reaction, is an ideal organism for studying the relative importance of mass-transfer and kinetics since the cell concentration in continuous reactors employing R. rubrum may be regulated by the quantity of light supplied to the bacterium. This article addresses the performance of R. rubrum in continuous stirred-tank and trickle-bed reactors, with particular attention given to the importance of mass-transfer and reaction kinetics in modeling reactor performance. Estimates of mass-transfer coefficients are made for a trickle-bed reactor system based upon reactor performance equations and experimental observations. R. rubrum. Mathematical expressions were developed for the trickle-bed reactor and the continuous-stirred tank reactor in order to separate mass-transfer and kinetic limitations. These equations showed, as expected, that multiple experiments with various cell concentration levels must be conducted to yield definite conclusions regarding mass-transfer coefficients. The cell concentrations using R. rubrum were easily controlled by regulating the light supply. The experimental results showed that the mass-transfer coefficients were affected by liquid flow rates and that the values obtained were of the same order of magnitude as those found in the literature.

0802 Storage, Transport, and Handling

Refer also to citation(s) 3928

0804 Economic, Industrial, and Business Aspects

Refer also to citation(s) 3671

09 BIOMASS FUELS

0907 Resources

2861 (DOE/OR/21389–37) **Northeast Regional Biomass Program ninth year, third quarter report, April–June 1992.** Lusk, P.D. CONEG Policy Research Center, Inc., Washington, DC (United States). Jul 1992. 15p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG05-83OR21389. Order Number DE93002790. Source: OSTI; NTIS; GPO Dep.

The Northeast Regional Biomass Program (NRBP) operates using a state grant component that provides funds (with a 50 percent matching requirement) to each of the states in the region to strengthen and integrate the work of state agencies involved in biomass energy; a series of technical reports and studies in areas that have been identified as being of critical importance to the development of biomass energy in the region; and a continuous long range planning component with heavy private sector involvement

that helps to identify activities necessary to spur greater development and use of biomass energy in the Northeast. This report describes the activities of NRBP between April and June, 1992.

0909 Processing

Refer also to citation(s) 2527, 4187, 4269, 4270, 4271, 4272, 4273, 4292

2862 (ANL/CP–77167) **Recent research efforts in the area of biotechnology for fuels and chemicals: Poster session papers.** Antonopoulos, A.A. (Argonne National Lab., IL (United States)); Grohmann, K. Argonne National Lab., IL (United States). [1992]. 10p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-31109-ENG-38. (CONF-920508–5: 14. symposium on biotechnology for fuels and chemicals, Gatlinburg, TN (United States), 11-15 May 1992). Order Number DE92041130. Source: OSTI; NTIS; GPO Dep.

This report presents research presented at the poster session of the Symposium covering a wide spectrum of current biotechnological research activities. Research focused mostly on ethanol production and methane generation from biomass material via microbial processing, as well as on enhanced hydrogen yield from algae. Several of the posters dealt with the pretreatment of cellulosic materials, and enzyme production/characterization, while a good number of papers displayed research efforts on bioremediation, photosynthesis, production of various useful chemicals from biomass by bioprocessing, and on other miscellaneous subjects. One of the papers treated a very interesting topic of cellulose-cellulase complexes. Many of the poster papers are included in this volume, and a synopsis of all the poster/papers presented is the subject of this article.

2863 (CONF-910550–, pp. 5-21) **Pretreatment of lignocellulosic municipal solid waste by ammonia fiber explosion (AFEX).** Holtzapple, M.T. (Texas A and M Univ., College Station (United States)); Lundeen, J.E.; Sturgis, R.; Lewis, J.E.; Dale, B.E. National Renewable Energy Lab., Golden, CO (United States); Oak Ridge National Lab., TN (United States). 1992. From 13. symposium on biotechnology for fuels and chemicals; Colorado Springs, CO (United States); 6-10 May 1991. In *Thirteenth symposium on biotechnology for fuels and chemicals: Proceedings.* 846p. Source: The Humana Press, Inc., Totowa, NJ 07511 (United States).

The Ammonia Fiber Explosion (AFEX) process treats lignocellulose with high-pressure liquid ammonia and then explosively releases the pressure. The combined chemical effect (cellulose decrystallization) and physical effect (increased accessible surface area) dramatically increase lignocellulose susceptibility to enzymatic attack. For example, bagasse digestibility is increased 5.5 times and that of kenaf core is increased 11 times using extracellular cellulases from Trichoderma reesei. In this study, the authors applied the AFEX process to mixed municipal solid waste (MSW) and individual components (e.g., softwood newspaper, kenaf newspaper, copy paper, paper towels, cereal boxes, paper bags, corrugated boxes, magazines, and waxed paper). Softwood newspaper proved to be the most difficult component to digest because of its high lignin content. A combination of oxidative lignin cleavage and AFEX was required to increase softwood newspaper digestibility substantially, whereas AFEX alone was able to make kenaf newspaper digestible. Because most MSW components have been substantially delignified in the paper-making process, AFEX only marginally increased their digestibility.

2864 (CONF-910550–, pp. 23-35) **Effects of cell-wall acetate, xylan backbone, and lignin on enzymatic hydrolysis of aspen wood.** Kong, F. (Texas A and M Univ. System, College System (United States)); Engler, C.R.; Soltes, E.J. National Renewable Energy Lab., Golden, CO (United States); Oak Ridge National Lab., TN (United States). 1992. From 13. symposium on biotechnology for fuels and chemicals; Colorado Springs, CO (United States); 6-10 May 1991. In *Thirteenth symposium on biotechnology for fuels and chemicals: Proceedings.* 846p. Source: The Humana Press, Inc., Totowa, NJ 07511 (United States).

Aspen wood substrates with varying degrees of deacetylation, xylan, and lignin removal have been prepared and submitted to enzymatic hydrolysis with a cellulase/hemicellulase preparation for an extended constant period of hydrolysis. Controlled deacetylation has been achieved by treating wood with various alkali metal hydroxide solutions, at various alkali/wood ratios. It has been found that samples with the same extent of deacetylation produce the same sugar yields upon enzymatic hydrolysis. Increased degree of deacetylation increases the yield of sugars obtained from enzymatic hydrolysis, all other compositional parameters held constant. The acetyl group removal is proportional to the stoichiometric relation between added base and wood acetyl content, i.e., the same number of milliequivalents of base/weight of wood remove the same extent of acetyl groups, regardless of the concentration of the base solution. No cation effects are found among Li, Na, and K alkali hydroxide solutions, suggesting that swelling is not as important a parameter as is the removal of the acetyl groups from the xylan backbone in determining the extent of hydrolyzability of the resulting sample.

2865 (CONF-910550–, pp. 37-48) **Comparison of steam pretreatment of eucalyptus, aspen, and spruce wood chips and their enzymatic hydrolysis.** Ramos, L.P. (Univ. of British Columbia, Vancouver (Canada)); Breuil, C.; Saddler, J.N. National Renewable Energy Lab., Golden, CO (United States); Oak Ridge National Lab., TN (United States). 1992. From 13. symposium on biotechnology for fuels and chemicals; Colorado Springs, CO (United States); 6-10 May 1991. In *Thirteenth symposium on biotechnology for fuels and chemicals: Proceedings.* 846p. Source: The Humana Press, Inc., Totowa, NJ 07511 (United States).

Enzymatic hydrolysis of SO_2-impregnated, steam-exploded Eucalyptus viminalis was carried out at increasing substrate concentrations and enzyme loadings. When low enzyme loadings were used, the peroxide-treated fraction derived from eucalyptus chips (SEE-WIA/H_2O_2) was more readily hydrolyzed than the water-insoluble (SEE-WI) and the alkali-insoluble (SEE-WIA) fractions. The various cellulosic fractions derived from steam-exploded E. viminalis exhibited a greater susceptibility to hydrolysis than the equivalent aspen and spruce substrates, particularly at high substrate concentrations (10%, w/v).

2866 (CONF-910550–, pp. 61-74) **On the use of enzyme adsorption and specific hydrolysis rate to characterize thermal-chemical pretreatment.** Wang, S.S. (Dartmouth College, Hanover, NH (United States)); Converse, A.O. National Renewable Energy Lab., Golden, CO (United States); Oak Ridge National Lab., TN (United States). 1992. From 13. symposium on biotechnology for fuels and chemicals; Colorado Springs, CO (United States); 6-10 May 1991. In *Thirteenth symposium on biotechnology for fuels and chemicals: Proceedings.* 846p. Source: The Humana Press, Inc., Totowa, NJ 07511 (United States).

The pseudo enzyme adsorption isotherm of the pretreated substrate is used to estimate the pretreatment's effectiveness in generating accessible adsorption sites. The specific hydrolysis rate (i.e., the hydrolysis rate divided by the adsorbed enzyme) is used as a measure of substrate reactivity. Poplar, subjected to partial acid hydrolysis at 180 and 200C in 1% H_2SO_4 for 9 s, was contacted with GC 123 (a Trichoderma reesei cellulase produced by Genencor, Inc., South San Francisco, CA). Both adsorption capacity and specific reaction rate increase significantly at the higher pretreatment temperature. The absolute rate and the specific hydrolysis rate fall off rapidly with conversion, and the absolute rate, but not the specific rate, exhibits a maximum as enzyme concentration is increased.

2867 (CONF-910550–, pp. 75-91) **Determination of reaction kinetics of wheat straw using thermogravimetric analysis.** Ergudenler, A. (Technical Univ. of Nova Scotia, Halifax (Canada)); Ghaly, A.E. National Renewable Energy Lab., Golden, CO (United States); Oak Ridge National Lab., TN (United States). 1992. From 13. symposium on biotechnology for fuels and chemicals; Colorado Springs, CO (United States); 6-10 May 1991. In *Thirteenth symposium on biotechnology for fuels and chemicals: Proceedings.* 846p. Source: The Humana Press, Inc., Totowa, NJ 07511 (United States).

Thermogravimetric analysis (TGA) and differential thermal analysis (DTA) have been conducted on straws from four different wheat varieties (Absolvant, Max, Monopol, and Vuka) in an oxidizing atmosphere of 15% oxygen and 85% nitrogen. The thermal degradation of wheat straw was studied from ambient temperature to 700C using a heating rate of 20C/min. By applying thermoanalytical techniques to reaction kinetics, the order of reaction, preexponential factor, and energy of activation were determined from thermogravimetric curves. Two distinct reaction zones were observed on the TGA and DTA curves. Because of the two-step nature of the thermal degradation of wheat straw, it was essential to determine the kinetic parameters for each zone separately. The thermal degradation rate of the first zone was significantly higher than that of the second zone for all wheat straw varieties. Lower activation energy and preexponential factors were observed for wheat straws as compared to cellulose owing to the high inorganic material and silica contents of the wheat straw.

2868 (CONF-910550–, pp. 93-104) **Simulation of ethanol production processes based on enzymatic hydrolysis of lignocellulosic materials using ASPEN PLUS.** Galbe, M. (Univ. of Lund (Sweden)); Zacchi, G. National Renewable Energy Lab., Golden, CO (United States); Oak Ridge National Lab., TN (United States). 1992. From 13. symposium on biotechnology for fuels and chemicals; Colorado Springs, CO (United States); 6-10 May 1991. In *Thirteenth symposium on biotechnology for fuels and chemicals: Proceedings.* 846p. Source: The Humana Press, Inc., Totowa, NJ 07511 (United States).

The process simulator ASPEN PLUS was used for simulation of an ethanol production process based on enzymatic hydrolysis of lignocellulosic materials. The effect of water recycling, necessary to reduce the amount of waste water and to increase the ethanol concentration in the feed to the distillation, was investigated. For a process based on 20 t/h raw material, the amount of waste water can be reduced from 70.7 t/h, without recycling, to 7.1 t/h. Furthermore, the ethanol concentration in the distillation feed increased from 2.5 to 10%. The concentration of byproducts and possible inhibitors increased by a factor of 20-40 in the hydrolysis and fermentation steps. This gives new conditions for futurehydrolysis and fermentation experiments.

2869 (CONF-910550–, pp. 105-113) **Recovery of cellulases after hydrolysis by adsorption on steam-pretreated willow.** Eklund, R. (Univ. of Lund (Sweden)); Galbe, M.; Zacchi, G. National Renewable Energy Lab., Golden, CO (United States); Oak Ridge National Lab., TN (United States). 1992. From 13. symposium on biotechnology for fuels and chemicals; Colorado Springs, CO (United States); 6-10 May 1991. In *Thirteenth symposium on biotechnology for fuels and chemicals: Proceedings.* 846p. Source: The Humana Press, Inc., Totowa, NJ 07511 (United States).

Processes based on enzymatic saccharification for the production of ethanol from lignocellulosics are yet not economically feasible. One of the most crucial steps is the enzymatic hydrolysis. Enzyme recycling could improve the economics since the cost of enzymes constitutes a major part of the total cost of hydrolysis. In a previous paper, the adsorption of enzymes on fresh substrate, steam pretreated willow, was studied focusing on the adsorption capacity of the substrate. It was shown that a large fraction of the enzymes in solution could be adsorbed. A major problem is the recovery of the enzymes that remain adsorbed on the hydrolysis residue. These account for the main part of the total amount of enzymes, at least when low enzyme loadings (below 20 FPU/g substrate) are used in the hydrolysis. Higher enzyme loadings will naturally result in a higher degree of recovery, but will not reduce the total amount of enzymes consumed. Sinitsyn et al. have shown that the recovery of endoglucanases from the solid residue was enhanced by neutralizing the pH from 4.5, the optimum for hydrolysis. The recovery may also be enhanced by the addition of chemicals. The results from some preliminary experiments on the desorption of cellulases from the hydrolysis residue are shown. The desorption was performed by batchwise washing using buffer solution or tap water. Although the elution power of common tapwater is low, some desorption occurs even after four washes. This encouraged us to further explore the desorption step. The present study was concerned with the investigation of the effect of temperature and pH on the recycling of cellulases based on desorption from the hydrolysis residue and readsorption on fresh substrate. The desorption-adsorption process is performed in a continuously working unit with a recirculating wash stream. The degree of cellulase recycling is assayed by hydrolysis.

2870 (CONF-910550–, pp. 115-123) **Dilute-acid pretreatment of two short-rotation herbaceous crops.** Torget, R. (Solar Energy Research Inst., Golden, CO (United States)); Himmel, M.; Grohmann, K. National Renewable Energy Lab., Golden, CO (United States); Oak Ridge National Lab., TN (United States). 1992. From 13. symposium on biotechnology for fuels and chemicals; Colorado Springs, CO (United States); 6-10 May 1991. In *Thirteenth symposium on biotechnology for fuels and chemicals: Proceedings.* 846p. Source: The Humana Press, Inc., Totowa, NJ 07511 (United States).

The development of fuel ethanol from cellulosic biomass is of increasing importance to provide an alternative transportation fuel. The primary purpose of pretreatment is to make the cellulosic biomass amenable to the action of cellulase enzymes. In the case of dilute-acid pretreatment, which is a widely accepted method at the present time, acids hydrolyze the hemicellulose fraction of biomass to primarily xylose (and a few other minor sugars) in solution leaving a porous solid substrate that is accessible for conversion to ethanol. The key requirements are to maximize the susceptibility of cellulose to hydrolysis to glucose while minimizing the loss of sugars (primarily xylose and glucose) during the pretreatment step. Research has focused on identification of suitable lignocellulosic biomass feedstocks for pretreatment and bioconversion to fuel-grade ethanol. The authors have previously measured the performance of dilute-sulfuric acid prehydrolysis for several high-productivity energy crops (HPEC) currently undergoing large-scale production/availability studies. At moderate temperatures (120-180C) and low-acid loading (0.8-1.1 wt% acid), a digestible pulp is produced while minimizing degradation of the soluble hemicellulosic sugars for all species tested other than legumeous species. These species seem to require harsher pretreatment conditions than were studied to yield completely digestible pulps. The authors have previously demonstrated that two factors seem to affect the yields of glucose from the enzymatic breakdown of cellulose: (1) dilute-acid-mediated xylan removal and (2) temperature of pretreatment for some species. In this study, the authors are extending the previous work to include dilute-acid pretreatment of the legume, flatpea hay, and the grass, reed canary grass, to culminate the initial screening of selected HPEC from ORNL as to the efficacy of dilute-acid pretreatment for ethanol synthesis.

2871 (CONF-910550–, pp. 125-129) **On fermentability of nafion catalyzed hemicellulose hydrolyzates.** Chung, B.H. (Kyung Hee Univ., Suwon (Korea)); Kim, C.H.; Chung, I.S.; Balagopal, V.G.; Lee, Y.Y. National Renewable Energy Lab., Golden, CO (United States); Oak Ridge National Lab., TN (United States). 1992. From 13. symposium on biotechnology for fuels and chemicals; Colorado Springs, CO (United States); 6-10 May 1991. In *Thirteenth symposium on biotechnology for fuels and chemicals: Proceedings.* 846p. Source: The Humana Press, Inc., Totowa, NJ 07511 (United States).

Production of alcohol and other chemicals from replenishable resources is currently attracting renewed attention. Many problems exist in the extraction of the sugars and in the subsequent bioconversion of the sugars to ethanol. Extraction of sugars from hemicellulose and cellulose requires a hydrolytic catalyst, acid or enzyme. In the case of acid catalyst, an inherent problem exists in that the hydrolysis reaction is accompanied by degradation of sugar product (1,2). Recently, there has been considerable interest in the use of superacids (better proton donors than pure H_2SO_4) for hydrolysis of polysaccharides. Hardt and Lamport studied the saccharification of wood by hydrogen fluoride and found it to have a much higher catalytic activity than sulfuric acid. Superacid catalysts also exhibit higher selectivity toward the hydrolytic reaction. This study was undertaken to ascertain the fermentability of the hydrolyzates produced by a solid superacid, Nafion.

2872 (CONF-910550–, pp. 135-148) **Hemicellulose bioconversion to polyanionic heteropolysaccharides.** Tanenbaum,

S.W. (State University of New York, Syracuse (United States)); Fisher, P.J.; Henwood, A.; Novak, J.; Scott, B.; Nakas, J.P. National Renewable Energy Lab., Golden, CO (United States); Oak Ridge National Lab., TN (United States). 1992. From 13. symposium on biotechnology for fuels and chemicals; Colorado Springs, CO (United States); 6-10 May 1991. In *Thirteenth symposium on biotechnology for fuels and chemicals: Proceedings*. 846p. Source: The Humana Press, Inc., Totowa, NJ 07511 (United States).

Anionic polysaccharides, traditionally obtained from plant or algal sources, have a variety of commercial uses. Such gums from microorganisms have received increased recent interest. The authors have initiated a program to investigate the bioconversion of pentosans to rheologically useful anionic extracellular polysaccharides (AEPS). A number of earlier-described species, including Cryptococcus laurentii, Klebsiella pneumoniae, Arthrobacter viscosus, and Pseudomonas ATCC 31260, appear to have potential in this regard. These organisms can individually convert either xylose, enzymatic oligomeric hemicellulose digests, dilute mineral acid hemicellulose ('TVA') hydrolysates, or a five-monosaccharide mixture simulating sulfite process liquors to AEPS. The formation parameters, compositions, mol-wt distributions, and the intrinsic viscosities of these purified AEPS are exemplified. Substitution of pentose as the major substrate for glucose can result in changes in mol-wt distribution or in the percentage of noncarbohydrate substituents in some AEPS. Pursuit of these observations may lead to interesting structure-property relationships and toward rheological applications for pentosan-derived AEPS.

2873 (CONF-910550–, pp. 149-159) **Enhancement of 1,3-propanediol production by cofermentation in Escherichia coli expressing Klebsiella pneumoniae dha regulon genes.** Tong, I.-T. (Univ. of Wisconsin, Madison (United States)); Cameron, D.C. National Renewable Energy Lab., Golden, CO (United States); Oak Ridge National Lab., TN (United States). 1992. From 13. symposium on biotechnology for fuels and chemicals; Colorado Springs, CO (United States); 6-10 May 1991. In *Thirteenth symposium on biotechnology for fuels and chemicals: Proceedings*. 846p. Source: The Humana Press, Inc., Totowa, NJ 07511 (United States).

1,3-Propanediol (1,3-PD) is an intermediate in chemical and polymer synthesis. The authors have previously expressed the genes of a biochemical pathway responsible for 1,3-PD production, the dha regulon of Klebsiella pneumoniae, in Escherichia coli. An analysis of the maximum theoretical yield of 1,3-PD from glycerol indicates that the yield can be improved by the cofermentation of sugars, provided that kinetic constraints are overcome. The yield of 1,3-PD from glycerol was improved from 0.46 mol/mol with glycerol alone to 0.63 mol/mol with glucose cofermentation and 0.55 mol/mol with xylose cofermentation. The engineered E. coli also provides a model system for the study of metabolic pathway engineering.

2874 (CONF-910550–, pp. 185-204) **Effect of acetic acid on xylose conversion to ethanol by genetically engineered E. coli.** Lawford, H.G. (Univ. of Toronto, ON (Canada)); Rousseau, J.D. National Renewable Energy Lab., Golden, CO (United States); Oak Ridge National Lab., TN (United States). 1992. From 13. symposium on biotechnology for fuels and chemicals; Colorado Springs, CO (United States); 6-10 May 1991. In *Thirteenth symposium on biotechnology for fuels and chemicals: Proceedings*. 846p. Source: The Humana Press, Inc., Totowa, NJ 07511 (United States).

Efficient utilization of the pentosan fraction of hemicellulose from lignocellulosic feedstocks offers an opportunity to increase the yield and to reduce the cost of producing fuel ethanol. During prehydrolysis, acetic acid is formed as a consequence of the deacetylation of the acetylated moiety of hemicellulose. Recombinant Escherichia coli B (ATCC 11303), carrying the plasmid pLO1297 with pyruvate decarboxylase and alcohol dehydrogenase 11 genes from Zymomonas mobilis (CP4), converts xylose to ethanol with a product yield that approaches theoretical maximum. Although other pentose-utilizing microorganisms are inhibited by acetic acid, the recombinant E. coli displays a high tolerance for acetic acid. In xylose fermentations with a synthetic medium (Luria broth), where the pH was controlled at 7, neither yield nor productivity was affected by the addition of 10.7 g/L acetic acid. Nutrient- supplemented, hardwood (aspen) hemicellulose hydrolysate (40.7 g/L xylose) was completely fermented to ethanol (16.3 g/L) in 98 h. When the acetic acid concentration was reduced from 5.6 to 0.8 g/L, the fermentation time decreased to 58 h. Overliming' with $Ca(OH)_2$ to pH 10, followed by neutralization to pH 7 with sulfuric acid and removal of insolubles, resulted in a twofold increase in volumetric productivity. The maximum productivity was 0.93 g/L/h. The xylose-to- ethanol conversion efficiency and productivity in $Ca(OH)_2$-treated hardwood prehydrolysate, fortified with only mineral salts, were 94% and 0.26 g/L/h, respectively. The recombinant E. coli exhibits a xylose-to-ethanol conversion efficiency that is superior to that of other pentose-utilizing yeasts currently being investigated for the production of fuel ethanol from lignocellulosic materials.

2875 (CONF-910550–, pp. 205-216) **The effect of lactic acid on fuel ethanol production by Zymomonas.** Lawford, H.G. (Univ. of Toronto, ON (Canada)); Rousseau, J.D. National Renewable Energy Lab., Golden, CO (United States); Oak Ridge National Lab., TN (United States). 1992. From 13. symposium on biotechnology for fuels and chemicals; Colorado Springs, CO (United States); 6-10 May 1991. In *Thirteenth symposium on biotechnology for fuels and chemicals: Proceedings*. 846p. Source: The Humana Press, Inc., Totowa, NJ 07511 (United States).

Lactic acid bacteria have a profoundly negative influence on the fermentation performance of Zymomonas mobilis. Lactic acid bacteria are an important part of the steeping process in starch wet-milling. Their prevalence and acid pH optimum for growth make these organisms opportunistic contaminants of continuous ethanol fermentations, where the feedstock is enzymatic starch hydrolysate. At concentrations of lactic acid in the range of 3-10 g/L, cell density, product yield, and productivity are reduced. However, under similar operating conditions, a chemostat culture fed a synthetic glucose medium with added DL-lactic acid (range 0-13 g/L) did not exhibit a decrease in either yield or productivity. In ph-stat (5.0) batch cultures, with about 11 g/L lactic acid added to the medium, growth and conversion efficiency were only very slightly inhibited. At pH 4.5, this amount of lactic acid caused a 23% decrease in growth yield, but only a 3% reduction in ethanol yield. Acetic acid is a minor metabolic byproduct of tactic cultures, and at pH 5, the growth rate and growth yield of Z. mobilis were inhibited 17 and 23% respectively, by the addition of 3.37 g/L lactic acid. Ethanol yield was decreased only 3.5% by this amount of acetic acid. It is concluded that lactic acid per se is not the causative inhibitory agent. Also, although a possible role for acetic acid and unidentified natural antibiotic substances is implied, the mechanism whereby lactic acid bacteria negatively affect Zymomonas remains unresolved.

2876 (CONF-910550–, pp. 309-316) **Plant processing by simultaneous lactic acid fermentation and enzyme hydrolysis.** Tengerdy, R.P. (Colorado State Univ., Fort Collins (United States)); Linden, J.C.; Wu, M.; Murphy, V.G.; Baintner, F.; Szakacs, G. National Renewable Energy Lab., Golden, CO (United States); Oak Ridge National Lab., TN (United States). 1992. From 13. symposium on biotechnology for fuels and chemicals; Colorado Springs, CO (United States); 6-10 May 1991. In *Thirteenth symposium on biotechnology for fuels and chemicals: Proceedings*. 846p. Source: The Humana Press, Inc., Totowa, NJ 07511 (United States).

Traditional ensiling of plant material by anaerobic lactic acid fermentation was combined with enzymatic hydrolysis (ENLAC for short) with cell wall degrading enzymes (hemicellulases, cellulases, and pectinases) to increase fiber digestibility or to increase the recovery of cell content from plants. Such findings were made using 0.015% (w/w, wet basis) Phylacell enzyme preparation by ENLAC of corn and corn-sorghum mixtures, but not of forage grasses. Addition to alfalfa of a mixture of cell wall degrading enzymes, such as NOVO Viscozyme together with NOVO Celluclast each at 0.2-1.0% (w/w, wet basis), resulted in more rapid ensiling and improvement of rumen digestibility of silage by 20%. After 20 d of ensiling at 25C when the same enzymes were added to alfalfa at the 1.0% level, protein recovery by pressing increased by 35%, β-carotene recovery by 80%, and chlorophyll/xanthophyll recovery by 30%. ENLAC with the same enzymes also increased the recovery of sclareol from muscatel sage by 400%.

2877 (CONF-910550–, pp. 331-339) **Genetic engineering of microalgae for fuel production.** Dunahay, T.G. (National Renewable Energy Lab., Golden, CO (United States)); Jarvis, E.E.; Zeiler,

K.G.; Roessler, P.G.; Brown, L.M. National Renewable Energy Lab., Golden, CO (United States); Oak Ridge National Lab., TN (United States). 1992. From 13. symposium on biotechnology for fuels and chemicals; Colorado Springs, CO (United States); 6-10 May 1991. In *Thirteenth symposium on biotechnology for fuels and chemicals: Proceedings.* 846p. Source: The Humana Press, Inc., Totowa, NJ 07511 (United States).

The NREL Culture Collection contains a number of microalgae strains that have potential for growth in mass culture and that accumulate large quantities of lipids under conditions of nutrient stress. The authors plan to use recombinant DNA technologies to regulate lipid accumulation and growth characteristics of the algae in order to establish conditions for economically feasible liquid fuel production. in order to use recombinant DNA technologies to manipulate algal biosynthetic pathways, there is a need to develop genetic transformation systems for the algae of interest. In this article, progress is reviewed towards the introduction of DNA into algal cells, monitoring of expression of foreign genes, and the development of methods to promote stable expression of exogenous DNA in the algae. Once the technology is available for algal transformation, genes that affect the quantity or quality of lipid accumulation in the algal cells will be substituted for the marker genes.

2878 (CONF-910550–, pp. 341-347) **Cellobiose hydrolysis by glutaraldehyde-treated β-glucosidase entrapped in propylene glycol alginate/bone gelatin spheres.** Woodward, J. (Oak Ridge National Lab., TN (United States)); Capps, K.M. National Renewable Energy Lab., Golden, CO (United States); Oak Ridge National Lab., TN (United States). 1992. DOE Contract AC05-84OR21400. From 13. symposium on biotechnology for fuels and chemicals; Colorado Springs, CO (United States); 6-10 May 1991. In *Thirteenth symposium on biotechnology for fuels and chemicals: Proceedings.* 846p. Source: The Humana Press, Inc., Totowa, NJ 07511 (United States).

Aspergillus niger β-glucosidase is a suitable enzyme with which to supplement, and hence enhance, the activity of fungal cellulases because it has high cellobiase specific activity. It will thus hydrolyze cellobiose and prevent end-product inhibition of the cellobiohydrolase component of the cellulase complex mixture of enzymes from fungal sources, such as Trichoderma reesei. Furthermore, it can be added to a reaction mixture containing cellulase in an immobilized form because its substrates are soluble. Recently, the authors reported the entrapment of this enzyme adsorbed on concanavalin A-Sepharose (CAS) within propylene glycol alginate/bone gelatin (PGAG) spheres. In order to impart structural stability to the spheres, it was necessary to store them in sodium hydroxide for several minutes after their formation. However, this resulted in desorption of the enzyme from CAS and its subsequent leakage out of the spheres. In an attempt to overcome this problem, A. niger β-glucosidase was treated with glutaraldehyde, instead of being immobilized on CAS, prior to its entrapment in PGAG spheres. This was done in order to polymerize the enzyme so that it would not leak out of the spheres and enable the spheres to be stored in sodium hydroxide for longer than 4 min, resulting in greater structural stability. Previous data have shown glutaraldehyde-treated β-glucosidase to be retained within calcium alginate spheres. In this article, the authors present preliminary data suggesting that glutaral-dehyde-treated β-glucosidase is almost as active as the native enzyme, possesses enhanced thermal stability, and, when entrapped within PGAG gel spheres, can be used for the continuous hydrolysis of cellobiose in a fixed-bed reactor. As noted previously, the spheres are maintenance-free in that they do not require exogenously added ions for their structural stability.

2879 (CONF-910550–, pp. 349-357) **Properties of the seed gum of Stryphnodendron barbatiman (barbatimao).** Reicher, F. (Dept. of Biochemistry (Brazil)); Leitner, S.; Fontana, J.D.; Correa, J.; Sierakowski, M.R. National Renewable Energy Lab., Golden, CO (United States); Oak Ridge National Lab., TN (United States). 1992. From 13. symposium on biotechnology for fuels and chemicals; Colorado Springs, CO (United States); 6-10 May 1991. In *Thirteenth symposium on biotechnology for fuels and chemicals: Proceedings.* 846p. Source: The Humana Press, Inc., Totowa, NJ 07511 (United States).

Water soluble polysaccharides are finding a steadily widening range of industrial uses, notably as additives in food, pharmaceuticals, cosmetics, paper products, paints and plastics, and in oil well drilling muds, mining, and explosives. Their utility is based on functional characteristics. Before polysaccharides can be optimally exploited by industry, it is necessary to develop rules to predict their structure-function relationships. The effect of monosaccharide composition, configuration, and position of glycosidic linkages, type of sugar side chain, level of substitution and distribution of substituents along the main chain, conformation, and physical properties must be analyzed. Thus, the galactomannans, which are found as endosperm cell wall storage polysaccharides in many leguminous seeds, exhibit a wide range of novel and commercially useful rheological properties. S. barbatiman seeds contained 30% of galactomannan, and its mannose to galactose ratio and $[\eta]$ are similar to those of guar gum (i.e., 1.5-1.0 and 1400 mL/g), respectively. It was observed that its useful rheology was dependent on the extraction process employed. When the benzene-ethanol pretreatment was used prior to aqueous extraction, the product was not viscous. In contrast, aqueous methanol pretreatment, followed by aqueous extraction at room temperature, afforded very viscous galactomannan solutions. Since most studies on polysaccharide properties are performed with commercial samples, the aim of the present investigation is to correlate methods of polysaccharide preparation from S. barbatiman seeds with the more interesting property of viscous solution formation.

2880 (CONF-910550–, pp. 359-368) **Performance of microorganisms in spent sulfite liquor and enzymatic hydrolysate of steam-pretreated salix.** Olsson, L. (Univ. of Lund (Sweden)); Linden, T.; Hahn-Hagerdal, B. National Renewable Energy Lab., Golden, CO (United States); Oak Ridge National Lab., TN (United States). 1992. From 13. symposium on biotechnology for fuels and chemicals; Colorado Springs, CO (United States); 6-10 May 1991. In *Thirteenth symposium on biotechnology for fuels and chemicals: Proceedings.* 846p. Source: The Humana Press, Inc., Totowa, NJ 07511 (United States).

The earth's oil reserves are limited, and the availability and price are subject to constant variations. In this perspective, ethanol produced from renewable resources, such as wood, represents an alternative to fossil fuels. It has been shown that the price of the raw material represents a major fraction of the final price of lignocellulose-derived ethanol. Therefore, the highest possible conversion yield is a prerequisite for a future ethanol production from lignocellulose, which means that all the sugars in a wood hydrolysate have to be fermented. In addition, the pretreatment and hydrolysis of a lignocellulosic substrate may give rise to inhibitors that reduce the rate of fermentation and prevent a complete conversion of the fermentable sugars to ethanol. Lignocellulose consists of 10-40% xylose, which can be fermented to ethanol by bacteria, yeasts, or fungi. None of these species fulfill the demands of efficiently fermenting a lignocellulosic substrate to ethanol. It is therefore desirable either to adapt or construct an organism that efficiently ferments all sugars in a nondetoxified lignocellulose hydrolysate. The construction of xylose-fermenting microorganisms by genetic engineering has been done and is under current investigation. In this article, the authors have studied the performance of some prospective candidates for genetic transformation in two different technical substrates, spent sulfite liquor and steam-pretreated enzymatically hydrolyzed Salix.

2881 (CONF-910550–, pp. 369-375) **The effect of oxygenation on glucose fermentation with Pichia stipitis.** Skoog, K. (Chemical Center, Lund (Sweden)); Jeppsson, H.; Hahn-Hagerdal, B. National Renewable Energy Lab., Golden, CO (United States); Oak Ridge National Lab., TN (United States). 1992. From 13. symposium on biotechnology for fuels and chemicals; Colorado Springs, CO (United States); 6-10 May 1991. In *Thirteenth symposium on biotechnology for fuels and chemicals: Proceedings.* 846p. Source: The Humana Press, Inc., Totowa, NJ 07511 (United States).

Pentose fermentation is a problem for the biotechnological industry concerned with the efficient utilization of plant biomass for ethanol production. Lignocellulosic biomass consists of hemicellulose, cellulose, and lignin. The main component in hemicellulose is

xylose, and in cellulose, it is glucose. These sugars can be fermented to fuel ethanol. Pichia stipitis is one of the better xylose-fermenting yeasts, but it requires carefully controlled oxygenation for efficient ethanol production. Oxygen has also been shown to be important for ethanol production from glucose. Therefore, the fermentation of lignocellulosic hydrolysates-containing both hexoses and pentoses-with P. stipitis requires well-controlled fermentations for efficient ethanol production. The role of oxygen for efficient ethanol formation during pentose fermentations has given rise to several hypotheses about the xylose metabolism: 1. Oxygen is necessary to maintain the redox balance in the first two steps of the xylose metabolism; 2. Oxygen is necessary for the transport of xylose. Oxygen is necessary for growth; and 4. Oxygen is necessary for unimpaired mitochondrial function. With the aim of further elucidating the role of oxygen in maintaining the redox balance in the first two steps during the xylose metabolism, the authors investigated the fermentation of glucose in continuous culture with either oxygen limitation and an excess of glucose or glucose limitation and an excess of oxygen. At each steady state, product formation, intracellular enzyme activities (pyruvate decarboxylase [PDC], malate dehydrogenase [MDH]), and concentrations of intracellular intermediary metabolites (fructose 1.6-diphosphate [FDP], pyruvate [Pyr], and malate [Mal]) were measured.

2882 (CONF-910550–, pp. 383-389) **Plasmids from thermophilic Clostridia.** Kalyuzhnyi, S.V. (M.V. Lomonosov Moscow Univ. (USSR)); Mosolova, T.P.; Belogurova, N.G.; Varfolomeyev, S.D. National Renewable Energy Lab., Golden, CO (United States); Oak Ridge National Lab., TN (United States). 1992. From 13. symposium on biotechnology for fuels and chemicals; Colorado Springs, CO (United States); 6-10 May 1991. In *Thirteenth symposium on biotechnology for fuels and chemicals: Proceedings.* 846p. Source: The Humana Press, Inc., Totowa, NJ 07511 (United States).

Clostridia present an area of great potential interest to biotechnology, because among their metabolic products are some prospective biofuels (ethanol, butanol, acetone, hydrogen), useful organic acids (acetic, propionic, butyric, and so forth), and technologically important enzymes (cellulases, hemicellulases, and so on). Particular attention is paid to the thermophilic species of these bacteria according to the following: First, under thermophilic conditions, the realization of technological processes is made easier (lower oxygen solubility, lower demands for sterility, higher metabolic rates), and second, many enzymes isolated from thermophilic species feature a notable thermostability. At the same time, Clostridia possess some disadvantages that prevent their use in biotechnology: relatively lower growth rates, strict observance of anaerobiosis, and lower yield of necessary products. One of the ways to overcome these disadvantages may be to construct new strains with desirable properties by means of genetic engineering methods. Today the solution of this problem is impossible because appropriate cloning vectors are absent and convenient systems for genetic engineering manipulation in Clostridia are not developed. The aim of this short review is to present a generalization of data on the availability of plasmids in thermophilic Clostridia, including a description of their properties as well as attempts to construct convenient vectors on their basis. Experimental data from studying plasmids from C. thermosaccharolyticum DSM 571 will also be listed.

2883 (CONF-910550–, pp. 395-417) **Ethanol, the ultimate feedstock: A technoeconomic evaluation of ethanol manufacture in fluidized bed bioreactors operating with immobilized cells.** Busche, R.M. (Bio En-Gene-Er Associates, Inc., Wilmington, DE (United States)); Scott, C.D.; Davison, B.H.; Lynd, L.R. National Renewable Energy Lab., Golden, CO (United States); Oak Ridge National Lab., TN (United States). 1992. From 13. symposium on biotechnology for fuels and chemicals; Colorado Springs, CO (United States); 6-10 May 1991. In *Thirteenth symposium on biotechnology for fuels and chemicals: Proceedings.* 846p. Source: The Humana Press, Inc., Totowa, NJ 07511 (United States).

Ethanol appears to be a key factor in the 'biomass alternative' to fossil feedstocks for producing fuels and chemicals. If produced at a low enough price relative to crude oil, it and its derivatives could account for 159 billion pounds, or 50%, of the US production of synthetic organic chemicals, presently valued at $113 billion. This use would consume 4.2 billion bushels, or about 54%, of the corn crop. This study evaluated the potential savings in ethanol manufacture to be gained by applying advanced process engineering or genetic engineering of improved organisms, centering on the use of fluidized bed bioreactors operating at high cell densities with immobilized cells of either the Saccharomyces yeast or the bacterium: Zymomonas mobilis. A new continuous plant could produce at about $1.82/gal based on Zymomonas or $1.97/gal based on the Saccharomyces yeast. The bacterium has a competitive edge as a result of its lower sensitivity to product inhibition. There appears to be no inherent design limitation to effect the engineering improvements required for the advanced process. In a longer-term, more difficult research effort, it might be possible to reduce or eliminate product inhibition to reduce cost even further.

2884 (CONF-910550–, pp. 419-430) **Experimental analysis of a product inhibited fermentation in an aqueous two-phased system.** Kim, Y.-J. (Univ. of Maryland, College Park (United States)); Weigand, W.A. National Renewable Energy Lab., Golden, CO (United States); Oak Ridge National Lab., TN (United States). 1992. From 13. symposium on biotechnology for fuels and chemicals; Colorado Springs, CO (United States); 6-10 May 1991. In *Thirteenth symposium on biotechnology for fuels and chemicals: Proceedings.* 846p. Source: The Humana Press, Inc., Totowa, NJ 07511 (United States).

Two aqueous two-phased systems were investigated to determine their ability to reduce product inhibition in the acetone-butanol-ethanol (A-B-E) fermentation. In an attempt to avoid the high cost of fractionated dextran, an industrial-grade dextran (DEX) and a hydroxylpropyl starch polymer, whose commercial name is Aquaphase PPT (APPT), were tested as the copolymer with polyethylene glycol (PEG) to form the two-phased fermentation broth. The two-phased fermentation performances in the DEX-PEG and APPT-PEG two-phase systems were compared to a single-phased conventional fermentation through a series of batch runs. Also, the effects of the phase forming polymers on Clostridium acetobutylicum were investigated. With the butanol partition coefficient of 1.3, which is defined as the concentration ratio of butanol in the continuous and dispersed phases, the butanol yield with the two-phased system was increased by 27% in comparison to the conventional fermentation.

2885 (CONF-910550–, pp. 431-439) **Simultaneous fermentation and separation of lactic acid in a biparticle fluidized-bed bioreactor.** Davidson, B.H. (Oak Ridge National Lab., TN (United States)); Thompson, J.E. National Renewable Energy Lab., Golden, CO (United States); Oak Ridge National Lab., TN (United States). 1992. DOE Contract AC05-84OR21400. From 13. symposium on biotechnology for fuels and chemicals; Colorado Springs, CO (United States); 6-10 May 1991. In *Thirteenth symposium on biotechnology for fuels and chemicals: Proceedings.* 846p. Source: The Humana Press, Inc., Totowa, NJ 07511 (United States).

A bioreactor configuration has been tested for simultaneous fermentation and separation of the desired inhibitory product, lactic acid. The bioreactor is a fluidized bed of immobilized Lactobacillus delbreuckii. Another solid phase of denser sorbent particles (a polyvinyl pyridine resin) was added to this fluidized bed. These sorbent particles fell through the bed, absorbed the product, and were removed. In test fermentations, the addition of the sorbent enhanced the fermentation and moderated the fall of the pH. The biparticle fluidized-bed bioreactor utilizing immobilized microorganisms and adsorbent particles has been shown to enhance the production of lactic acid fourfold in this nonoptimized system.

2886 (CONF-910550–, pp. 441-448) **Application of novel technology to the ABE fermentation process: An economic analysis.** Qureshi, N. (Massey Univ., Palmerston North, (New Zealand)); Maddox, I.S. National Renewable Energy Lab., Golden, CO (United States); Oak Ridge National Lab., TN (United States). 1992. From 13. symposium on biotechnology for fuels and chemicals; Colorado Springs, CO (United States); 6-10 May 1991. In *Thirteenth symposium on biotechnology for fuels and chemicals: Proceedings.* 846p. Source: The Humana Press, Inc., Totowa, NJ 07511 (United States).

Traditional technology for ABE production and recovery does not allow an economic process. However, use of a fluidized-bed reactor using immobilized cells in a continuous fermentation process, coupled with product removal and concentration by a membrane process, is a viable option. The major factor affecting product price is the substrate cost. Membrane selectivity and flux have little effect.

2887 (CONF-910550–, pp. 467-475) **The influence of physical properties on the operation of a three-phase fluidized-bed fermentor with yeast cells immobilized in Ca-alginate.** Bejar, P. (Univ. Autonoma de Barcelona (Spain)); Casas, C.; Godia, F.; Sola, C. National Renewable Energy Lab., Golden, CO (United States); Oak Ridge National Lab., TN (United States). 1992. From 13. symposium on biotechnology for fuels and chemicals; Colorado Springs, CO (United States); 6-10 May 1991. In *Thirteenth symposium on biotechnology for fuels and chemicals: Proceedings.* 846p. Source: The Humana Press, Inc., Totowa, NJ 07511 (United States).

A three-phase fluidized-bed bioreactor with Ca-alginate immobilized yeast cells in which an external air stream is introduced to promote and maintain fluidization was studied with respect to its characterization and air-flow optimization. The fluidization behavior is very strongly dependent on the physical properties of both liquid and solid phases (liquid viscosity, density, surface tension, and solid density). Satisfactory or unsatisfactory fluidization behavior could be determined in a graph on the basis of two parameters calculated with the values of the physical properties. A correlation on the minimum air-flow rate necessary to obtain acceptable fluidization of the immobilized yeast beads was developed using experimental data obtained in two fermentors with different L/D ratios.

2888 (CONF-910550–, pp. 499-510) **Bioconversion of vanillin into vanillic acid by Pseudomonas fluorescens strain BTP9: Cell reactors and mutants study.** Bare, G. (Univ. de Liege, Sart-Tilman (Belgium)); Gerard, J.; Jacques, Ph.; Delaunois, V.; Thonart, Ph. National Renewable Energy Lab., Golden, CO (United States); Oak Ridge National Lab., TN (United States). 1992. From 13. symposium on biotechnology for fuels and chemicals; Colorado Springs, CO (United States); 6-10 May 1991. In *Thirteenth symposium on biotechnology for fuels and chemicals: Proceedings.* 846p. Source: The Humana Press, Inc., Totowa, NJ 07511 (United States).

The ability of a fluorescent Pseudomonas to bioconvert vanillin, a phenolic compound, into vanillic acid was investigated. Free and immobilized cell reactors were tested. With free cells, the optimal yield reaches 98% after 6 h and 30 min of bioconversion. With cells immobilized in alginate beads, transformation rate is only 47% after 13 h of conversion. Nevertheless, a continuous immobilized cell reactor was used for 76 h. With this one, the optimal yield is higher than 80%. The influence of the residence time and cell concentration of the alginate beads in the reactor over the reactor's productivity has also been studied. Catabolically blocked mutants for vanillic acid degradation were searched. To screen these mutants, a new and very sensitive method was reported. The results of mutant screenings were discussed.

2889 (CONF-910550–, pp. 515-526) **Conversion of bioprocess ethanol to industrial chemical products: Applications of process models for energy-economic assessments.** Rohatgi, N.K. (California Inst. of Technology, Pasadena (United States)); Ingham, J.D. National Renewable Energy Lab., Golden, CO (United States); Oak Ridge National Lab., TN (United States). 1992. From 13. symposium on biotechnology for fuels and chemicals; Colorado Springs, CO (United States); 6-10 May 1991. In *Thirteenth symposium on biotechnology for fuels and chemicals: Proceedings.* 846p. Source: The Humana Press, Inc., Totowa, NJ 07511 (United States).

Ethanol is commercially produced by bioconversion and by hydration of ethylene. Bioconversion has the significant advantage that utilization of nonrenewable petroleum resources is minimized. Advanced bioprocesses for aqueous ethanol can also be integrated with downstream systems for energy-efficient conversion to added-value chemicals, such as esters or other ethylene or ethanol derivatives. Since the energy-intensive step involving azeotrope dehydration is eliminated, net process energy requirements can be less than for production of anhydrous ethanol. Energy-economic assessments of a potential esterification process are described, where ethanol vapor in the presence of water from a bioreactor is catalytically converted to ethyl acetate. A commercial ASPEN process simulation program was used, and results were compared with an assessment based on a JPL computer model. Detailed evaluations of the sensitivity of cost of production to factors, such as material costs and annual production rates, were also completed.

2890 (CONF-910550–, pp. 527-541) **Direct microbial conversion: Prospects, progress, and obstacles.** Hogsett, D.A. (Dartmouth College, Hanover, NH (United States)); Ahn, H.-J.; Bernardez, T.D.; South, C.R.; Lynd, L.R. National Renewable Energy Lab., Golden, CO (United States); Oak Ridge National Lab., TN (United States). 1992. From 13. symposium on biotechnology for fuels and chemicals; Colorado Springs, CO (United States); 6-10 May 1991. In *Thirteenth symposium on biotechnology for fuels and chemicals: Proceedings.* 846p. Source: The Humana Press, Inc., Totowa, NJ 07511 (United States).

Process development is reviewed for ethanol production from cellulosic biomass via direct microbial conversion (DMC). Experimental data addressing cellulase production and ethanol tolerance are also presented for the candidate DMC organisms Clostridium thermocellum and Clostridium thermosaccharolyticum. Two potential paths are identified for obtaining organisms for use in DMC. Path 1 involves modification of excellent ethanol producers, so that they also become good cellulase producers; Path 2 involves modification of excellent cellulase producers, so that they also become good ethanol producers. Cellulase production, ethanol tolerance, and ethanol selectivity are considered for both Path 1 and Path 2 organisms. It is concluded that in situ cellulase production has the potential to allow cost reductions relative to state-of-the-art process designs on the order of 50cts/gal. Based on the data available, the value of cellulase production by C. thermocellum corresponds to 90% of this amount. However, each process path has a strategic obstacle to be overcome: high-level cellulase expression and secretion for Path 1, and high ethanol selectivity for Path 2. Ethanol tolerance is not seen as a primary factor in choosing between DMC and other ethanol process alternatives.

2891 (CONF-910550–, pp. 543-556) **Mathematical modeling of cellulose conversion to ethanol by the simultaneous saccharification and fermentation process.** Philippidis, G.P. (National Renewable Energy Lab., Golden, CO (United States)); Spindler, D.D.; Wyman, C.E. National Renewable Energy Lab., Golden, CO (United States); Oak Ridge National Lab., TN (United States). 1992. From 13. symposium on biotechnology for fuels and chemicals; Colorado Springs, CO (United States); 6-10 May 1991. In *Thirteenth symposium on biotechnology for fuels and chemicals: Proceedings.* 846p. Source: The Humana Press, Inc., Totowa, NJ 07511 (United States).

Ethanol, a promising alternative fuel, can be produced by the simultaneous saccharification and fermentation (SSF) of lignocellulosic biomass, which combines the enzymatic hydrolysis of cellulose to glucose and the fermentation of glucose to ethanol by yeast in a single step. A mathematical model that depicts the kinetics of SSF has been developed based on considerations of the quality of the substrate and enzyme, and the substrate-enzyme-microorganism interactions. Critical experimentation has been performed in conjunction with multiresponse nonlinear regression analysis to determine key model parameters regarding cell growth and ethanol production. The model will be used for rational SSF optimization and scale-up.

2892 (CONF-910550–, pp. 557-568) **Simultaneous saccharification and extractive fermentation for acetone/butanol production from pretreated hardwood.** Shah, M.M. (Auburn Univ., AL (United States)); Lee, Y.Y. National Renewable Energy Lab., Golden, CO (United States); Oak Ridge National Lab., TN (United States). 1992. From 13. symposium on biotechnology for fuels and chemicals; Colorado Springs, CO (United States); 6-10 May 1991. In *Thirteenth symposium on biotechnology for fuels and chemicals: Proceedings.* 846p. Source: The Humana Press, Inc., Totowa, NJ 07511 (United States).

An integrated bioreactor-extractor was investigated for applicability in simultaneous saccharification and extractive fermentation (SSEF), and production of acetone/butanol from pretreated hardwood by Clostridium acetobutylicum and cellulase enzymes. The SSEF system was constructed such that products of fermentation were extracted from the broth through a semipermeable membrane. In situ removal of inhibitory products was found to be beneficial in sustaining cell viability, thus allowing fed-batch operation of the bioreactor over a period of several weeks. Hardwood chips were pretreated by monoethanolamine in such a way that hemicellulose and cellulose were retained in high yield. The feed material thus prepared was readily converted by SSEF. The ability of C. acetobutylicum to ferment both glucose and xylose was a major factor in simplifying the overall process into a single-stage operation.

2893 (CONF-910550–, pp. 569-583) **A novel fermentation process for calcium magnesium acetate (CMA) production from cheese whey.** Yang, S.T. (Ohio State Univ., Columbus (United States)); Tang, I.C.; Zhu, H. National Renewable Energy Lab., Golden, CO (United States); Oak Ridge National Lab., TN (United States). 1992. From 13. symposium on biotechnology for fuels and chemicals; Colorado Springs, CO (United States); 6-10 May 1991. In *Thirteenth symposium on biotechnology for fuels and chemicals: Proceedings.* 846p. Source: The Humana Press, Inc., Totowa, NJ 07511 (United States).

A novel, anaerobic fermentation process is developed to produce calcium magnesium acetate (CMA) from cheese whey. CMA can be used as a noncorrosive road deicer. It poses no environmental threats and has many advantages over road salt. A coculture consisting of homolactic and homoacetic bacteria was used to convert whey lactose to lactate and then to acetate in a continuous, immobilized cell bioreactor. The acetate yield from lactose was ~ 95% (wt/wt) in this homofermentative process. The acetic acid produced from fermentation was recovered in a concentrated CMA solution by using an energy-efficient extraction process. The development of a novel, extractive fermentation process to reduce product inhibition and to further increase reactor productivity is also discussed.

2894 (CONF-910550–, pp. 585-596) **Simulation and optimization of a cell recycle system.** Warren, R.K. (Univ. of Saskatchewan, Saskatoon (Canada)); Hill, G.A.; Macdonald, D.G. National Renewable Energy Lab., Golden, CO (United States); Oak Ridge National Lab., TN (United States). 1992. From 13. symposium on biotechnology for fuels and chemicals; Colorado Springs, CO (United States); 6-10 May 1991. In *Thirteenth symposium on biotechnology for fuels and chemicals: Proceedings.* 846p. Source: The Humana Press, Inc., Totowa, NJ 07511 (United States).

This article describes the simulation and subsequent optimization of a cell recycle fermentor and membrane filter in a wheat-to-ethanol process. The optimum conditions with respect to economic operating performance were found using a search method similar to steepest gradients. Optimum fermentor cell and inlet substrate concentrations were 54 and 127 g/L, respectively. The study also involved the effects of parameter variations on net cost, and the effects of raw material and product prices on profitability. The net cost was found to be most sensitive to the product yield and wheat costs.

2895 (CONF-910550–, pp. 597-612) **Production of β-1,3-glucan exopolysaccharide in low shear systems: The requirement for high oxygen systems.** Lawford, H.G. (Univ. of Toronto, ON (Canada)); Rousseau, J.D. National Renewable Energy Lab., Golden, CO (United States); Oak Ridge National Lab., TN (United States). 1992. From 13. symposium on biotechnology for fuels and chemicals; Colorado Springs, CO (United States); 6-10 May 1991. In *Thirteenth symposium on biotechnology for fuels and chemicals: Proceedings.* 846p. Source: The Humana Press, Inc., Totowa, NJ 07511 (United States).

A patent culture of Alcaligenes faecalis var. myxogenes (ATCC 31749) synthesizes 'curdlan' during the stationary phase of an aerobic batch fermentation following the depletion of assimilable nitrogen. Because this β-1,3-homoglucan exopolymer is water insoluble, the fermentation broth is of a relatively low viscosity, and consequently offers little resistance to oxygen transfer from gas to the liquid. However, the layer of insoluble exopolymer surrounding the cell mass offers a resistance to oxygen transfer from the liquid to the cell, thereby necessitating an unexpectedly high dissolved oxygen concentration for maximal productivity. The shear sensitive nature of this fermentation restricts improving oxygen transfer by increasing agitation intensity. The requirement for high volumetric oxygen transfer can be met by low shear designs with axial-flow impellers, providing gas dispersion is assisted by the use of sparging devices consisting of microporous materials. The specific respiration rates for growing and curdlan-producing stationary-phase culture were determined to be 7 and 2.7 mmol O_2/g cell/h, respectively. At a cell density of 3 g cell/L, the maximal rate of curdlan biosynthesis was about 100 mg/g cell/h, with a requirement for dissolved oxygen (DO) of 6.5 mg O_2/L (86% air saturation at 30 C and 1 atm.). Whereas, at constant impeller speed, the volumetric oxygen transfer was improved both by increasing the air sparging rate and by using O_2-enriched air (30% O_2), productivity was not consistently improved by operating at a twofold higher cell density and at a DO > 6.5 Mg O_2/L. At higher cell densities, it would appear that shear must be increased to minimize culture clumping and assist in oxygen transfer to the cell.

2896 (CONF-910550–, pp. 625-637) **Enzymatic saccharification of industrial and agricultural lignocellulosic wastes.** Gusakov, A.V. (Moscow State Univ. (Russian Federation)); Sinitsyn, A.P.; Manenkova, J.A.; Protas, O.V. National Renewable Energy Lab., Golden, CO (United States); Oak Ridge National Lab., TN (United States). 1992. From 13. symposium on biotechnology for fuels and chemicals; Colorado Springs, CO (United States); 6-10 May 1991. In *Thirteenth symposium on biotechnology for fuels and chemicals: Proceedings.* 846p. Source: The Humana Press, Inc., Totowa, NJ 07511 (United States).

Cellolignin, an industrial residue obtained during the production of furfural from wood and corn cobs, when pretreated by diluted H_2SO_4 at elevated temperature, may be considered as a potential substrate for enzymatic saccharification. Cellulose fractions of these substrates can almost completely be converted to glucose by cellulases from T. viride and A. foetidus. The concentration of glucose in hydrolyzates achieves 4-5.5%. A mathematical model for enzymatic hydrolysis of lignocellulose was developed. Using mathematical modeling of the process, an attempt was undertaken to estimate the relative influence of various factors on the efficiency of lignocellulose hydrolysis.

2897 (CONF-910550–, pp. 639-649) **Preliminary estimate of the cost of ethanol production for SSF technology.** Hinman, N.D. (Solar Energy Research Inst., Golden, CO (United States)); Schell, D.J.; Riley, C.J.; Bergeron, P.W.; Walter, P.J. National Renewable Energy Lab., Golden, CO (United States); Oak Ridge National Lab., TN (United States). 1992. From 13. symposium on biotechnology for fuels and chemicals; Colorado Springs, CO (United States); 6-10 May 1991. In *Thirteenth symposium on biotechnology for fuels and chemicals: Proceedings.* 846p. Source: The Humana Press, Inc., Totowa, NJ 07511 (United States).

The Solar Energy Research Institute (SERI) recently completed a detailed engineering and economic analysis of the simultaneous saccharification and fermentation (SSF) based wood-to-ethanol process. The reference-case design was based on a plant capacity of 1920 dry t/d and a wood cost of $42/dry t. For this case, the preliminary estimate of the production cost of the ethanol product is about $1.22/gal. The combined effects of optimizing SSF enzyme loading, increasing plant capacity to 10,000 dry t/d, and reducing wood cost to $34/dry t are to reduce the preliminary estimate of the production cost to about $0.95/gal. Other technological improvements may further reduce the production cost. Certain technical assumptions, inherent in the analysis, are being investigated further.

2898 (CONF-910550–, pp. 651-657) **Preliminary studies on the processing sequence for southern red oak and municipal solid waste using a hybrid dilute acid/enzymatic hydrolysis process for ethanol production.** Johnson, R.D. (Tennessee Valley Authority, Muscle Shoals, AL (United States)); Eley, M.H. National Renewable Energy Lab., Golden, CO (United States); Oak Ridge National Lab., TN (United States). 1992. From 13. symposium on biotechnology for fuels and chemicals; Colorado Springs, CO (United States); 6-10 May 1991. In *Thirteenth symposium on biotechnology for fuels and chemicals: Proceedings.* 846p. Source: The Humana Press, Inc., Totowa, NJ 07511 (United States).

Based on this preliminary study, a metric ton of dry southern red oak chips subjected to a first-stage dilute sulfuric acid hydrolysis would yield 132 kg of xylose and 40 kg of glucose and mannose. A second- stage dilute sulfuric acid hydrolysis on the first-stage residue would yield only 128 kg of additional glucose, but a second-stage cellulytic enzyme hydrolysis on the first-stage residue would yield an additional 265 kg of glucose. Fermentation of these hydrolyzates would show that the hybrid process would yield over 50% more ethanol. Results on other biomass are also included.

2899 (CONF-910550–, pp. 659-665) **Dilute sulfuric acid pretreatment of corn stover at high solids concentrations.** Schell, D.J. (National Renewable Energy Lab., Golden, CO (United States)); Walter, P.J.; Johnson, D.K. National Renewable Energy Lab., Golden, CO (United States); Oak Ridge National Lab., TN (United States). 1992. From 13. symposium on biotechnology for fuels and chemicals; Colorado Springs, CO (United States); 6-10 May 1991. In *Thirteenth symposium on biotechnology for fuels and chemicals: Proceedings.* 846p. Source: The Humana Press, Inc., Totowa, NJ 07511 (United States).

One of the more promising alternative fuels to replace gasoline is ethanol. However, in order to have a significant impact on current oil consumption, ethanol must be both inexpensive and plentiful. Lignocellulosic biomass, from such sources as energy crops, agricultural residues, and municipal solid waste, is one resource that is plentiful and could potentially produce inexpensive ethanol. One resource with the potential to produce large quantities of ethanol is agricultural residues. The US production of these residues is estimated at 300 million tons per year, with corn stover accounting for 150 million tons per year. This could potentially produce 15 billion gallons per year of ethanol, or approx 10% of current gasoline consumption. However, it is difficult to hydrolyze lignocellulosic biomass to glucose for subsequent conversion to ethanol because of the lignin-hemicellulose sheath that surrounds the cellulose and because of the crystallinity of the cellulose. Some form of pretreatment is needed to disrupt the sheath, increasing the susceptibility of the cellulose to enzymatic attack. Once the cellulose is converted to glucose, yeast can be used to ferment the glucose to ethanol. In this study, the authors investigated the effectiveness of a dilute sulfuric acid, high-solids (20-30%) pretreatment at different conditions on the enzymatic digestibility of corn stover. Corn stover (stalks and cobs) is defined as the residue remaining in the field after the corn kernels are harvested from the cob. In these experiments, the acid concentration was held constant, and the residence time and temperature were varied using a three-level full factorial design.

2900 (CONF-910550–, pp. 725-736) **Effects of natural polymer acetylation on the anaerobic bioconversion to methane and carbon dioxide.** Rivard, C.J. (National Renewable Energy Lab., Golden, CO (United States)); Adney, W.S.; Himmel, M.E.; Mitchell, D.J.; Vinzant, T.B.; Grohmann, K.; Moens, L.; Chum, H. National Renewable Energy Lab., Golden, CO (United States); Oak Ridge National Lab., TN (United States). 1992. From 13. symposium on biotechnology for fuels and chemicals; Colorado Springs, CO (United States); 6-10 May 1991. In *Thirteenth symposium on biotechnology for fuels and chemicals: Proceedings.* 846p. Source: The Humana Press, Inc., Totowa, NJ 07511 (United States).

The successful production of novel biodegradable plastic copolymers incorporating both synthetic plastic formulations, such as polystyrene, and naturally occurring biodegradable polymer components, such as cellulose, starch, or xylan, requires stable chemical bonding between these polymers. Modification of the natural polymers through acetylation of the available hydroxyl groups permits the formation of appropriate film-forming plastic copolymers. However, modification of natural polymers has been demonstrated to result in decreased attack by microbial catalysts. For this study, the abundant natural polymers cellulose, starch, and xylan were substituted with acetate to various degrees, and the effect of this modification on the anaerobic biodegradation was assessed using the biochemical methane potential (BMP) protocol. Significant reduction in anaerobic biodegradability resulted with all polymers at substitution levels of between 1.2-1.7. For the xylan acetate series, the trends for anaerobic biodegradation were in good agreement with reduced enzymatic hydyolysis using commercially available xylanase preparations.

2901 (CONF-910550–, pp. 737-751) **Efficacy of hydrolytic enzyme augmentation and thermochemical pretreatments for increased secondary anaerobic digestion of treated municipal sewage sludges.** Nagle, N.J. (Solar Energy Research Inst., Golden, CO (United States)); Rivard, C.J.; Adney, W.S.; Himmel, M.E. National Renewable Energy Lab., Golden, CO (United States); Oak Ridge National Lab., TN (United States). 1992. From 13. symposium on biotechnology for fuels and chemicals; Colorado Springs, CO (United States); 6-10 May 1991. In *Thirteenth symposium on biotechnology for fuels and chemicals: Proceedings.* 846p. Source: The Humana Press, Inc., Totowa, NJ 07511 (United States).

Rising costs for landfill disposal of municipal sewage residues have prompted evaluation of alternative methods for reducing the bulk of the final waste. Representative samples of municipal sewage sludge residues were obtained from three major treatment plants in the United States, including Los Angeles (Hyperion), Denver (North Metro), and Chicago (Stickney). The majority of the treated, dewatered sewage sludge solids was found to be volatile (50-60%) and, presumably, biodegradable. Additionally, much of the volatile content was solubilized by both acid detergent fiber and neutral detergent fiber treatments, and was presumed to be proteineous microbial biomass in nature. Both low- and high-solids anaerobic digester systems, as well as the standard biochemical methane potential (BMP) assay, were utilized to evaluate the anaerobic digestibility of these sewage sludge residues. The low methane yields and, thus, the poor organic waste conversion indicated the need for treatment prior to bioconversion. The effectiveness of various pretreatments based on assessment of increased soluble protein or organics and anaerobic digestibility as determined by the BMP assay was evaluated.

2902 (CONF-910550–, pp. 789-800) **Mixed- and plug-flow performances of an anaerobic biofilter treating 2-ethylhexanoic acid.** Chua, H. (National Univ. of Singapore (Singapore)); Yap, M.G.S.; Ng, W.J. National Renewable Energy Lab., Golden, CO (United States); Oak Ridge National Lab., TN (United States). 1992. From 13. symposium on biotechnology for fuels and chemicals; Colorado Springs, CO (United States); 6-10 May 1991. In *Thirteenth symposium on biotechnology for fuels and chemicals: Proceedings.* 846p. Source: The Humana Press, Inc., Totowa, NJ 07511 (United States).

The performance of a 20-L anaerobic biofilter treating 2-ethylhexanoic acid (2-EHA) operating with the effluent recirculated was compared with that of the same biofilter operated without any recirculation. The recirculation of effluent was at a rate of 60 L/h through the biofilter. Tracer experiments were carried out to study the hydrodynamics in the biofilter under different modes of operation. The dispersion number (D/UL) obtained from these tracer experiments for the biofilter operated with and without effluent recirculation were 0.65 and 0.06, respectively. These values show that the recirculation was effective in achieving a mixed-flow pattern in the biofilter, whereas the biofilter operated without recirculation was essentially a plug-flow column with a moderate level of axial dispersion. The feed consisted of 2-EHA at a concentration of 8200 mg/L, which is equivalent to a COD of 20,000 mg/L. The optimal performance of the mixed-flow biofilter was at a hydraulic retention time (HRT) of 1.1 d, with a COD removal efficiency of 92.8% and a biogas production rate of 6.44 L/L biofilter vol/d. The biofilter failed at 0.83 d HRT, as a result of washout of biomass at this high hydraulic loading rate. By comparison, the optimal performance achieved for the plug-flow system was at 2 d HRT. The COD removal efficiency was 74. 1 %, and biogas production rate was 2.13 L/L biofilter vol/d. When the HRT was lowered to 1.5 d, failure occurred owing to inhibition as indicated by the low methane yield of 0.192 L/g COD removed.

2903 (DOE/CE/15460–T8) **Portable high-speed biomass processor for Chunkwood: Final report.** Aikins, W.A. Aikins (Warren A.), Longview, WA (United States). 30 Oct 1992. 7p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG01-90CE15460. Order Number DE93002700. Source: OSTI; NTIS; INIS; GPO Dep.

All the design tasks for the Chunker/baler machine have been completed. The multiple blade shearing system and the chunkwood

baler were very challenging. I believe if there was a market for chunkwood, the redesigned Chunker would be a viable marketable product. It appears however that at best the market is very limited and would not justify an investment either by me or a possible licensee at this time. I do believe however, that eventually the costs for fossil fuels are going to rise to the point that chunkwood will be a profitable product. When this time arrives, we will have a god machine waiting in the wings to fill this future need.

2904 (DOE/ER/20053–1) **Mechanistic enzymology of CO dehydrogenase from Clostridium thermoaceticum: Progress report, August 15, 1993–March 24, 1995.** Ragsdale, S.W. Nebraska Univ., Lincoln, NE (United States). [1992]. 9p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG02-91ER20053. Order Number DE93002236. Source: OSTI; NTIS; GPO Dep.

The final steps in acetyl-CoA biosynthesis by anaerobic bacteria are performed by carbon monoxide dehydrogenase (CODH), a nickel/iron-sulfur protein. An important achievement was to establish conditions under which acetyl-CoA synthesis by purified enzymes equals the in vivo rate of acetate synthesis. Under these optimized conditions we established that the rate limiting step in the synthesis of acetyl-CoA from methyl-H_4folate, CO and CoA is likely to be the methylation of CODH by the methylated corrinoid/iron-sulfur protein. We then focused on stopped flow studies of this rate limiting transmethylation reaction and established its mechanism. We have studied the carbonylation of CODH by infrared and resonance Raman spectroscopy and determined that the [Ni-$Fe^{3-4}S_4$]-CO species which has been characterized by magnetic resonance methods can be described as [Ni-X-$Fe_{3-4}S_4$]-C≡O. We showed that this species is the catalytically competent precursor of the carbonyl group of acetyl-CoA. We have made progress in the synthesis of seleno-coenzyme A, which we will use to probe the binding of CoA to CODH. We also have compared the CODH from Methanosarcina thermophila with the C. thermoaceticum enzyme by EPR and electrochemical methods and found that the metal sites of these enzymes are remarkably similar given the evolutionary separation between archaea and bacteria domains.

2905 (Juel–2634) **Investigations about microbial protein degradation with the two-stage anaerobic waste water purification.** Winterberg, R. Forschungszentrum Juelich GmbH (Germany). Inst. fuer Biotechnologie; Duesseldorf Univ. (Germany). Jun 1992. 118p. (In German). Order Number DE93729095. Source: OSTI; NTIS (US Sales Only).

Wastewater reactors in which protein-containing industrial wastewaters were treated anaerobically were examined. It was shown that the protein degradation - in contrast to the carbohydrate degradation - is frequently incomplete. In six of seven examined acidification reactors of two-stage systems and in one of two one stage systems, the protein degradation was below 50%, while the coal hydrate degradation degree - with one exception - was more than 80%. A precondition for a complete protein degradation was a neutral pH. In acidification reactors operated with a pH below 5, no significant protein degradation took place. From the results, a two-stage process is derived as an optimal process for the anaerobic conversion of industrial wastewaters which apart from carbohydrates also contain proteins. Hydrolysis and fermentation of the carbohydrate take place in the first stage; in the second stage, the hydrolysis and fermentation of the proteins, the acetogenese and the methanogenesis take place. (orig./EF).

0910 Properties and Composition

Refer also to citation(s) 2572

0920 Combustion

Refer also to citation(s) 2572

0930 Economic, Industrial, and Business Aspects

Refer also to citation(s) 2883, 2886, 2889, 2894, 2897

0950 Environmental Aspects

2906 (CONF-9105393–1) **Carbon storage and recycling in short-rotation energy crops.** Ranney, J.W. (Oak Ridge National Lab., TN (United States)); Wright, L.L.; Mitchell, C.P. Oak Ridge National Lab., TN (United States). [1991]. 15p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. From International Energy Agency (IEA) executive committee meeting; Stockholm (Sweden); 1-2 May 1991. Order Number DE93001710. Source: OSTI; NTIS; INIS; GPO Dep.

Short-rotation energy crops can play a significant role in storing carbon compared to the agricultural land uses they would displace. However, the benefits from these plantations in avoiding further use of fossil fuel and in taking pressure off of native forests for energy uses provides longer term carbon benetfits than the plantation carbon sequestration itself. The fast growth and harvest frequency of plantations tends to limit the amount of above and below-ground carbon storage in them. The primary components of plantation carbon sequestering compared to sustained agricultural practices involve above-ground wood, possible increased soil carbon, litter layer formation, and increased root biomass. On the average, short-rotation plantations in total may increase carbon inventories by about 30 to 40 tonnes per hectare over about a 20- to 56-year period when displacing cropland. This is about doubling in storage over cropland and about one-half the storage in human-impacted forests. The sequestration benefit of wood energy crops over cropland would be negated in about 75 to 100 years by the use of fossil fuels to tend the plantations and handle biomass. Plantation interactions with other land uses and total landscape carbon inventory is important in assessing the relative role plantations play in terrestrial and atmospheric carbon dynamics. It is speculated that plantations, when viewed in this context. could trencrate a global leveling of net carbon emissions for approximately 10 to 20 years.

2907 (DOE/OR/21389–38) **The potential for biomass to mitigate greenhouse gas emissions in the Northeastern US: Northeast Regional Biomass Program.** Bernow, S.S.; Gurney, K.; Prince, G.; Cyr, M. Tellus Inst., Inc., Boston, MA (United States). Apr 1992. 197p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG05-83OR21389. Order Number DE93002800. Source: OSTI; OSTI; NTIS; GPO Dep.

This study, for the Northeast Regional Biomass Program (NRBP) of the Coalition of Northeast Governors (CONEG), evaluates the potential for local, state and regional biomass policies to contribute to an overall energy/biomass strategy for the reduction of greenhouse gas releases in the Northeastern United States. Biomass is a conditionally renewable resource that can play a dual role: by reducing emissions of greenhouse gases in meeting our energy needs; and by removing carbon from the atmosphere and sequestering it in standing biomass stocks and long-lived products. In this study we examine the contribution of biomass to the energy system in the Northeast and to the region's net releases of carbon dioxide and methane, and project these releases over three decades, given a continuation of current trends and policies. We then compare this Reference Case with three alternative scenarios, assuming successively more aggressive efforts to reduce greenhouse gas emissions through strategic implementation of energy efficiency and biomass resources. Finally, we identify and examine policy options for expanding the role of biomass in the region's energy and greenhouse gas mitigation strategies.

13 HYDRO ENERGY

1306 Environmental Aspects

Refer also to citation(s) 3469, 4175

1307 Power-Conversion Systems

2908 (ETDE-IT–92-96) **Research on off-design behaviour of Francis turbines: Overview of present state, difficulties, open problems, needs and strategies.** Fanelli, M. Ente Nazionale per l'Energia Elettrica, Milan (Italy). Centro di Ricerca Idraulica e

Strutturale. 1991. 21p. (CONF-9109444–1: 5. international meeting on the behaviour of hydraulic machinery, Milan (Italy), Sep 1991). Order Number DE93729465. Source: OSTI; NTIS (US Sales Only).

Although steady progress in overall knowledge, description and in-depth understanding of partial-load and overload regime phenomena occurring in Francis turbines has already been made, many essential points are still only qualitatively understood and/or empirically described. The aim of this paper is to briefly outline the present state of knowledge of several factors which bear on off-design hydrodynamic, hydro-mechanical, electromechanical and strongly linear interactions whose study requires a more sustained effort on different fronts of advanced experimental and mathematical research.

2909 (ETSU-SSH–4051) **Wells turbine pneumatic power conversion systems for river and tidal applications.** Whittaker, T.J.T.; Stinson, B. Queen's Univ., Belfast, Northern Ireland (United Kingdom). 1992. 168p. Order Number DE93733560. Source: OSTI; NTIS (US Sales Only).

The extraction of energy from very low heads in the range of 2 to 5m using conventional turbine technology tends to be expensive as a consequence of the large size of the prime movers and the gear ratio necessary to produce rotational motion at a speed compatible with conventional induction generators. The concept of using oscillating water columns, like those developed for wave power stations, driving self rectifying air turbines offers an alternative to conventional turbine and water wheel technology. In the concept examined in this study, twin oscillating water columns are forced to oscillate in anti-phase by the sequential opening and closing of valves in their bases. The primary objectives of the current programme of work were therefore to investigate in more detail the hydraulics of the water columns with particular emphasis on the turbine design. (author).

14 SOLAR ENERGY

1401 Resources and Availability

2910 (NREL/TP–463-5118) **A comparison of data from SOLMET/ERSATZ and the National Solar Radiation Data Base.** Marion, W.; Myers, D. National Renewable Energy Lab., Golden, CO (United States). Nov 1992. 34p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC02-83CH10093. Order Number DE93000018. Source: OSTI; NTIS; GPO Dep.

This report compares data from the new National Solar Radiation Data Base (NSRDB) with data from the earlier SOLMET/ERSATZ data base. It compares the two data bases, station-by-station, with respect to their long-term average daily values of global horizontal and direct normal solar radiation. We conclude that on an annual basis, NSRDB values for global horizontal radiation are within ±5% of SOLMET/ERSATZ values for 60% of the stations, more than 5% greater than the SOLMET/ERSATZ values for 30% of the stations, and more than 5% less than the SOLMET/ERSATZ values for 10% of the stations. On an annual basis for direct nominal radiation, the NSRDB values are with ±5% of the SOLMET/ERSATZ data for only 40% of the stations, more than 5% greater than the SOLMET/ERSATZ values for 45% of the stations, and more than 5% less than the SOLMET/ERSATZ values for 15% of the stations. In general, the NSRDB shows higher values of solar radiation for the eastern United States, particularly the Northeast, and lower values for some of the western states (Arizona, Colorado, Idaho, Nevada, New Mexico, Utah, and Wyoming). However, because some of the stations within a state show higher values of solar radiation while others show lower values, this generalization may be misleading when concerned with a particular station. Consequently, the appendices provide tables showing a station-by-station comparison of the NSRDB and SOLMET/ERSATZ data. In addition to comparing annual values, the tables compare the two data bases for the months of August and December. This comparison shows larger differences between the two data bases for December.

2911 **Apparatus for synthesis of a solar spectrum.** Sopori, B.L. To Dept. of Energy. 15 Mar 1991. USAA patent application 7-670,11. 31p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC02-83CH10093. Order Number DE93002026. Source: OSTI; NTIS; GPO Dep.

This invention is comprised of a xenon arc lamp and a tungsten filament lamp provide light beams that together contain all the wavelengths required to accurately simulate a solar spectrum. Suitable filter apparatus selectively direct visible and ultraviolet light from the xenon arc lamp into two legs of a trifurcated randomized fiber optic cable. Infrared light selectively filtered from the tungsten filament lamp is directed into the third leg of the fiber optic cable. The individual optic fibers from the three legs are brought together in a random fashion into a single output leg. The output beam emanating from the output leg of the trifurcated randomized fiber optic cable is extremely uniform and contains wavelengths from each of the individual filtered light beams. This uniform output beam passes through suitable collimation apparatus before striking the surface of the solar cell being tested. Adjustable aperture apparatus located between the lamps and the input legs of the trifurcated fiber optic cable and can be selectively adjusted to limit the amount of light entering each leg thereby providing a means of "fine tuning" or precisely adjusting the spectral content of the output beam. Finally, On adjustable aperture apparatus may also be placed in the output beam to adjust the intensity of the output beam without changing the spectral content and distribution of the output beam.

1403 Economic, Industrial, and Business Aspects

Refer also to citation(s) 2916

1405 Solar Energy Conversion

Refer also to citation(s) 3554, 3663, 3834, 3853, 4262, 4274

2912 (DOE/CH/10201–T3) **Maximally concentrating optics for photovoltaic solar energy conversion: Technical progress report, [July 1, 1984–January 31, 1985].** O'Gallagher, J.J. Chicago Univ., IL (United States). Enrico Fermi Inst. 7 Mar 1985. 39p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG02-84CH10201. Order Number DE93002846. Source: OSTI; NTIS; GPO Dep.

Use of a two-stage concentrator with a fresnel lens primary and a nonimaging dielectric totally internally reflecting secondary, has unique advantages for photovoltaic concentration. Some preliminary ray trace studies have shown that with planar lenses, an increase in angular acceptance for a given geometric concentration to about 2/3 of the maximum theoretical limit can be achieved. To demonstrate this, two preprototype concentrators, each having a geometric concentration of 248:1 for a 0.635cm (0.25 inch) diameter cell, have been designed, built, and tested. Measurements of the angular response show an acceptance of 8° (full angle) which is drastically better than the 1°–2° achievable without a secondary, and is in excellent agreement with the ray trace predictions. For these preprototypes, passive cooling was sufficient to prevent any thermal problems for both the cell and secondary. No problems associated with nouuniform cell illumination were found, as evidenced by the fill factor of 71%–73% measured under concentration. Initial measurements of the system electrical efficiency lie in the range 7.5%–9.9% for a variety of individual cells.

2913 (DOE/CH/10201–T4) **Maximally concentrating optics for photovoltaic solar energy conversion: Technical progress report, [July 1, 1985–February 15, 1986].** Winston, R.; O'Gallagher, J.; Ning, X. Chicago Univ., IL (United States). Enrico Fermi Inst. 27 Feb 1986. 54p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG02-84CH10201. Order Number DE93002845. Source: OSTI; NTIS; GPO Dep.

The use of a two-stage concentrator with a fresnel lens primary and a non-imaging dielectric totally internally reflecting secondary, has unique advantages for photovoltaic concentration. This new design has a much larger acceptance angle than the conventional lens-cell concentrating system. In the continuation of this research, an optimally designed prototype which employs a 13.6-cm diameter flat fresnel tons as the primary focusing device, a dielectric compound hyperbolic concentrator (DCHC) as secondary and a 1-cm diameter high-concentration cell for electricity conversion has been built, tested and analyzed. Measurements under sunlight show that

it has an angular acceptance of ±3.6 degrees, which is dramatically better than the ±0.5 degree achievable without a secondary concentrator. This performance agrees well with theoretical ray-tracing predictions. The secondary shows an optical efficiency of (91±2)% at normal incidence. Combining with the primary fresnel tens which has an optical efficiency of (82±2)%, tho two-stage system yields a total optical efficiency of (7l±2)%. The measurement of the system electrical performance yielded a net electrical efficiency of 11.9%. No problems associated with non-uniform cell illumination were found, as evidenced by the excellent fill factor of (79±2)% measured under concentration. The secondary geometrical properties and the optimal two-stage design procedures for various primary- cell combinations were systematical studied. A general design principle has been developed.

2914 (DOE/ER/13247–8) **Reaction kinetics and product distributions in photoelectrochemical cells: Technical progress report, March 15, 1992–March 14, 1993.** Koval, C.A. Colorado Univ., Boulder, CO (United States). [1992]. 5p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG02-84ER13247. Order Number DE93003885. Source: OSTI; NTIS; GPO Dep.

Hot electron reaction studies at p-InP/CH_3CN interface revealed essential/desirable features for redox systems used to investigate hot carriers in photoelectrocehmical cells. Reduction of dibromoethylbenzene (DBEB) in presence of metallocene couples is being studied using rotating rink disk electrodes of n-and p-InP disks and Pt rings. At highly doped p-InP electrodes, reduction of DBEB can be very efficient (>30%). A minielectrochemical cell was used to investigate electron transfer at nonilluminated n-WSe_2/dimethylferrocene$^{+/0}$ interfaces.

2915 (KIYal–91-8) **Change of solar cell element properties influenced by adsorbed atoms.** Livshits, A.I.; Romanovskij, Yu.A.; Zavilopulo, A.N.; Zhukov, A.I.; Snegurskij, A.V. AN Ukrainskoj SSR, Kiev (Ukraine). Inst. Yadernykh Issledovanij. 1991. 26p. (In Russian). Order Number DE93606694. Source: OSTI; NTIS (US Sales Only); INIS.

A series of experimental studies on the influence of alkali and alkaline-earth metal films on electro-physical properties of solar elements used for spacecraft energy supply was carried out. Metal films of different thicknesses were deposited using an effusion source, the mass of the film was calculated using measured atomic beam density. The Mg film thickness was determined by means of microscopic technique. The dynamics of current-to-voltage characteristic variation was studied for different film thickness and chemical composition in vacuum and in oxygen atmosphere. 23 refs.; 16 figs.; 2 tabs. (author).

2916 (NREL/TP–411-5018) **Photovoltaic manufacturing technology, Phase 1: Final technical report, 1 May 1991–10 May 1991.** National Renewable Energy Lab., Golden, CO (United States); Chronar Corp., Lawrenceville, NJ (United States). Oct 1992. 48p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC02-83CH10093. Order Number DE93000026. Source: OSTI; NTIS; GPO Dep.

This report describes subcontracted research by the Chronar Corporation, prepared by Advanced Photovoltaic Systems, Inc. (APS) for Phase 1 of the Photovoltaic Manufacturing Technology Development project. Amorphous silicon is chosen as the PV technology that Chronar Corporation and APS believe offers the greatest potential for manufacturing improvements, which, in turn, will result in significant cost reductions and performance improvements in photovoltaic products. The APS "Eureka" facility was chosen as the manufacturing system that can offer the possibility of achieving these production enhancements. The relationship of the "Eureka" facility to Chronar's "batch" plants is discussed. Five key areas are also identified that could meet the objectives of manufacturing potential that could lead to improved performance, reduced manufacturing costs, and significantly increased production. The projected long-term potential benefits of these areas are discussed, as well as problems that may impede the achievement of the hoped-for developments. A significant number of the problems discussed are of a generic nature and could be of general interest to the industry. The final section of this document addresses the cost and time estimates for achieving the solutions to the problems discussed earlier. Emphasis is placed on the number, type, and cost of the human resources required for the project.

2917 (NREL/TP–411-5019) **Photovoltaic Manufacturing Technology report, Phase 1: Final technical report, 9 January 1991–14 April 1991.** Mason, A.V.; Lillington, D.R. National Renewable Energy Lab., Golden, CO (United States); Spectrolab, Inc., Sylmar, CA (United States). Oct 1992. 136p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC02-83CH10093. Order Number DE93000027. Source: OSTI; NTIS; GPO Dep.

This report describes subcontracted research by Spectrolab, Inc., to address tasks outlined in the National Renewable Energy Laboratory's (NREL) Letter of solicitation RC-0-10057. These tasks include the potential of making photovoltaics (PV) a more affordable energy source, as set forth in the goal of the PVMaT project. Spectrolab believes that the DOE cost goals can be met using three different types of cells: (1) silicon concentrator cells, (2) high efficiency GaAs concentrator cells, and (3) mechanically stacked multijunction cells.

2918 (NREL/TP–411-5063) **Research on stable, high-efficiency amorphous silicon multijunction modules: Semiannual subcontract report, 1 January 1992–30 June 1992.** Guha, S. (United Solar Systems Corp., Troy, MI (United States)). National Renewable Energy Lab., Golden, CO (United States); United Solar Systems Corp., Troy, MI (United States). Sep 1992. 32p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC02-83CH10093. Order Number DE93000011. Source: OSTI; NTIS; GPO Dep.

This report describes research on semiconductor and non-semiconductor materials to enhance the performance of multi-band-gap, multijunction panel with an area greater than 900 cm^2 by 1992. Double-junction and triple-junction cells are mode on a Ag/ZnO back reflector deposited on stainless steel substrates. An a-SiGe alloy is used for the i-layer in the bottom and the middle cells; the top cell uses an amorphous silicon alloy. After the evaporation of an antireflection coating, silver grids and bus bars are put on the top surface and the panel is encapsulated in an ethylene vinyl acetate (EVA)/Tefzel structure to make a 1-ft^2 monolithic module.

2919 (NREL/TP–411-5123) **Electron cyclotron resonance deposition of amorphous silicon alloy films and devices: Final subcontract report, 1 April 1991–31 March 1992.** Shing, Y.H. (Jet Propulsion Lab., Pasadena, CA (United States)). National Renewable Energy Lab., Golden, CO (United States); Jet Propulsion Lab., Pasadena, CA (United States). Oct 1992. 58p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC02-83CH10093. Order Number DE93000023. Source: OSTI; NTIS; GPO Dep.

This report describes work to develop a state-of-the-art electron cyclotron resonance (ECR) plasma-enhanced chemical vapor deposition (PECVD) system. The objective was to understand the deposition processes of amorphous silicon (a-Si:H) and related alloys, with a best-effort improvement of optoelectronic material properties and best-effort stabilization of solar cell performance. ECR growth parameters were systematically and extensively investigated; materials characterization included constant photocurrent measurement (CPM), junction capacitance, drive-level capacitance profiling (DLCP), optical transmission, light and dark photoconductivity, and small-angle X-ray scattering (SAXS). Conventional ECR-deposited a-Si:H was compared to a new form, a-Si:(Xe, H), in which xenon gas was added to the ECR plasma. a-Si:(Xe,H) possessed low, stable dark conductivities and high photosensitivites. Light-soaking revealed photodegradation rates about 35% lower than those of comparable radio frequency (rf)-deposited material. ECR-deposited p-type a SiC:H and intrinsic a-Si:H films underwent evaluation as components of p-i-n solar cells with standard rf films for the remaining layers.

2920 (NREL/TP–412-5160) **FY 1991 Measurements and Characterization Branch annual report.** Osterwald, C.R.; Dippo, P.C. (eds.). National Renewable Energy Lab., Golden, CO (United States). Nov 1992. 52p. Sponsored by USDOE, Washington, DC

(United States). DOE Contract AC02-83CH10093. Order Number DE93000030. Source: OSTI; NTIS; GPO Dep.

The Measurements and Characterization Branch of the National Renewable Laboratory (NREL) provides comprehensive photovoltaic (PV) materials, devices, characterization, measurement, fabrication, modeling research, and support for the international PV research community, in the context of the US Department of Energy's Photovoltaic Research Program goals. This report summarizes the progress of the Branch from 31 January 1991 through 31 January 1992. The eight technical sections present a succinct overview of the capabilities and accomplishments of each group in the Branch. The Branch is comprised of the following groups: Surface and interface Analysis; Materials Characterization; Device Development; Electro-optical Characterization; Advanced PV module Performance and Reliability Research; Cell Performance Characterization; Surface Interactions, Modification, and Stability; and FTIR Spectroscopic Research. The including measurements and tests of PV materials, cells, submodules, and modules. The report contains a comprehensive bibliography of 77 branch originated journal and conference publications, which were authored in collaboration with, or in support of, approximately 135 university, industrial, government, and in-house research groups.

2921 (NREL/TP–413-5010) **Low-cost $CuInSe_2$ submodule development: Final subcontract report, 9 July 1990–31 January 1992.** Basol, B.M. (International Solar Electric Technology, Inglewood, CA (United States)); Kapur, V.K.; Halani, A.; Leidholm, C. National Renewable Energy Lab., Golden, CO (United States); International Solar Electric Technology, Inglewood, CA (United States). Oct 1992. 39p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC02-83CH10093. Order Number DE92016438. Source: OSTI; NTIS; GPO Dep.

Aim of this project is development and demonstration of processing steps necessary for fabrication of high efficiency $CuInSe_2$ solar cells and sub-modules by the two-stage technique (also called the selenization method.) During this period, we have optimized the processing parameters of this method and demonstrated $CuInSe_2$/CdS/ZnO devices with a 1–4 cm^2 area and up to 12.4% active area efficiency. We have also developed a novel approach for the preparation of Cu/In precursors that improved the stoichiometric and morphological uniformity in these films. We have developed processing steps and tooling for handling up to 1 ft^2 size substrates and as a result of these efforts demonstrated our first monolithically integrated sub-module of 1 ft^2 area. 16 figs, 1 tab, 15 refs.

2922 (NREL/TP–413-5012) **Research on polycrystalline thin-film $CuGaInSe_2$ solar cells: Annual subcontract report, 3 May 1991–2 May 1992.** Stanbery, B.J. (Boeing Co., Seattle, WA (United States). Defense and Space Systems Group); Chen, W.S.; Devaney, W.E.; Stewart, J.W. National Renewable Energy Lab., Golden, CO (United States); Boeing Co., Seattle, WA (United States). Defense and Space Systems Group. Nov 1992. 17p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC02-83CH10093. Order Number DE92016439. Source: OSTI; NTIS; GPO Dep.

This report describes research to fabricate high-efficiency CdZnS/$CuInGaSe_2$ (CIGS) thin-film solar cells, and to develop improved transparent conductor window layers such as ZnO. A specific technical milestone was the demonstration of an air mass (AM) 1.5 global, 13% efficient, 1-cm^2-total-area CIGS thin-film solar cell. Our activities focused on three areas. First, a CIGS deposition: system was modified to double its substrate capacity, thus increasing throughput, which is critical to speeding the process development by providing multiple substrates from the same CIGS run. Second, new tooling was developed to enable an investigation of a modified aqueous CdZnS process. The goal was to improve the yield of this critical step in the device fabrication process. Third, our ZnO sputtering system was upgraded to improve its reliability, and the sputtering parameters were further optimized to improve its properties as a transparent conducting oxide. The characterization of the new CIGS deposition system substrate fixturing was completed, and we produced good thermal uniformity and adequately high temperatures for device-quality CIGS deposition. Both the CIGS and ZnO deposition processes were refined to yield a ZnO// $Cd_{0.82}Zn_{0.18}S/CuIn_{0.80}Ga_{0.20}Se_2$ cell that was verified at NREL under standard testing conditions at 13.1% efficiency with V_{oc} = 0.581 V, J_{sc} = 34.8 mA/cm^2, FF = 0.728, and a cell area of 0.979 cm^2.

2923 **Current-matched, high-efficiency, multi-junction monolithic solar cells.** Olson, J.M.; Kurtz, S.R. To Dept. of Energy. 11 Feb 1991. USAA patent application 7-653,54. 36p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC02-83CH10093. Order Number DE93001997. Source: OSTI; NTIS; GPO Dep.

In this invention, the efficiency of a two-junction (cascade) tandem photovoltaic device is improved by adjusting (decreasing) the top cell thickness to achieve current matching. An example of the invention was fabricated out of $Ga_{0.52}In_{0.48}P$ and GaAs. Additional lattice-matched systems to which the invention pertains include Al_xGa_{1-x}/GaAs (x=0.3 – 0.4), GaAs/Ge and $Ga_yIn_{1-y}P/Ga_{y+0.5}In_{0.5-y}$ As (O<y<5).

2924 **Amorphous silicon/polycrystalline thin film solar cells.** Ullal, H.S. To Dept. of Energy. 13 Mar 1991. USAA patent application 7-668,84. 19p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC02-83CH10093. Order Number DE93002027. Source: OSTI; NTIS; GPO Dep.

An improved photovoltaic solar cell is described including a p-type amorphous silicon layer, intrinsic amorphous silicon, and an n-type polycrystalline semiconductor such as cadmium sulfide, cadmium zinc sulfide, zinc selenide, gallium phosphide, and gallium nitride. The polycrystalline semiconductor has an energy bandgap greater than that of the amorphous silicon. The solar cell can be provided as a single-junction device or a multijunction device.

2925 (SERI/CP–236-4396, pp. 13-15) **Photochemical solar energy conversion utilizing semiconductors located in membrane mimetic systems.** Fendler, J.H. (Syracuse Univ., NY (United States)). Solar Energy Research Inst., Golden, CO (United States). [1991]. (CONF-9106213–Absts.: 15. Department of Energy (DOE) solar photochemistry research conference, Snowmass, CO (United States), 2-6 Jun 1991). In *Fifteenth DOE solar photochemistry research conference.* 165p. Order Number DE91002165. Source: OSTI; NTIS.

Size-quantized semiconductor particulate films, generated in situ at monolayer surfaces and between Langmuir-Blodgett films, continue to be utilized as components of the artificial photosynthetic apparatus. The authors has characterized these films using absorption spectroscopy, X-ray diffractometry, and electrochemical measurements, along with several approaches using scanning tunneling microscopy. He has investigated the details of electron and photoelectron transfer for the purpose of elucidating the mechanisms.

2926 (SERI/CP–236-4396, pp. 89-92) **Photosynthetic energy conversion: Structure, mechanism, and function.** DiMagno, T.J. (Argonne National Lab., IL (United States)); Chen, L.X.Q.; Wang, Z.; Norris, J.R.; Chan, C.K.; Fleming, G.R. Solar Energy Research Inst., Golden, CO (United States). [1991]. (CONF-9106213–Absts.: 15. Department of Energy (DOE) solar photochemistry research conference, Snowmass, CO (United States), 2-6 Jun 1991). In *Fifteenth DOE solar photochemistry research conference.* 165p. Order Number DE91002165. Source: OSTI; NTIS.

Stark spectroscopy and transient absorption femtosecond spectroscopy on a series of mutated bacterial reaction centers have provided new experimental insight relevant to connecting the structure, mechanism, and function of the primary events of charge separation. The authors have addressed the three following issues: (1) the source of the observed unidirectional charge separation in the presence of two potential pathways related by approximate C2 symmetry; (2) the one step superexchange mechanism versus the two step, non-superexchange mechanism; (3) the fast forward reaction rate versus the slow back reaction rate. They have now completed an extensive investigation of the optical absorption spectroscopy of the reaction center.

2927 (SERI/CP–236-4396, pp. 131) **Initial electron transfer in bacterial photosynthetic reaction centers studied by femtosecond spectroscopies.** Chen, L.X.Q. (Argonne National Lab.,

IL (United States)); Norris, J.R.; Chan, C.K.; DiMagno, T.J.; Fleming, G.R. Solar Energy Research Inst., Golden, CO (United States). [1991]. (CONF-9106213–Absts.: 15. Department of Energy (DOE) solar photochemistry research conference, Snowmass, CO (United States), 2-6 Jun 1991). In *Fifteenth DOE solar photochemistry research conference.* 165p. Order Number DE91002165. Source: OSTI; NTIS.

The initial charge separation steps in the photosynthetic reaction centers of bacterial Rb. capsulatus mutants and Rb sphaeroides R26 were investigated by femtosecond optical transient spectroscopy. One of the authors goals is to reveal the cause of the unidirectionality of the chemistry and the mechanism of the initial electron transfer (step-wise vs. superexchange). They have also measured transient dichroism to resolve the reaction mechanism.

2928 (SERI/CP–236-4396, pp. 140) **Simulation of optical spectra and energy levels of semiconductor clusters.** Ramakrishna, M.V. (Columbia Univ., New York, NY (United States)); Friesner, R.A. Solar Energy Research Inst., Golden, CO (United States). [1991]. (CONF-9106213–Absts.: 15. Department of Energy (DOE) solar photochemistry research conference, Snowmass, CO (United States), 2-6 Jun 1991). In *Fifteenth DOE solar photochemistry research conference.* 165p. Order Number DE91002165. Source: OSTI; NTIS.

The authors have developed a pseudopotential model which accurately reproduces the size dependence of the optical excitation energy of small clusters of CdS, as measured experimentally by Wang and co-workers. They have used this model to study the energy levels of a cluster in an aqueous medium, employing an electron-water pseudopotential as well as potentials for the water-semiconductor interactions. Their ultimate objective is to simulate the dynamics of an electron excited into the conduction band, using a semiclassical surface hopping algorithm that they have successfully employed to study the relaxation of the solvated electron.

2929 (SERI/CP–236-4396, pp. 142) **Molecular processes and interactions of metal particles and ions with photosynthetic membranes.** Greenbaum, E. (Oak Ridge National Lab., TN (United States)). Solar Energy Research Inst., Golden, CO (United States). [1991]. (CONF-9106213–Absts.: 15. Department of Energy (DOE) solar photochemistry research conference, Snowmass, CO (United States), 2-6 Jun 1991). In *Fifteenth DOE solar photochemistry research conference.* 165p. Order Number DE91002165. Source: OSTI; NTIS.

At the chemical/molecular level, photosynthesis is vectorial photochemistry. The primary processes of photosynthesis occur in specialized reaction centers that have nanometer dimensions, picosecond response times, and generate electrical potential differences of approximately one volt. It has been discovered that the reducing end of Photosystem I can be electrically contacted by precipitating colloidal platinum onto the exterior surface of the thylakoid membrane. Spinach chloroplasts treated in this manner exhibited a novel photobiophysical phenomenon when subjected to laser radiation; photocurrent flowed through the biocomposite material.

2930 (SERI/CP–236-4396, pp. 161) **Primary events in isolated photosystem II reaction centers.** Seibert, M. (Solar Energy Research Inst., Golden, CO (United States)); Toon, S.; O'Neil, M.; Wasielewski, M. Solar Energy Research Inst., Golden, CO (United States). [1991]. (CONF-9106213–Absts.: 15. Department of Energy (DOE) solar photochemistry research conference, Snowmass, CO (United States), 2-6 Jun 1991). In *Fifteenth DOE solar photochemistry research conference.* 165p. Order Number DE91002165. Source: OSTI; NTIS.

A number of similarities have been noted between the bacterial and photosystem II (PSII) reaction center (RC) complexes. However, reliable spectral and kinetic studies of the isolated PSII RCs have been hindered by the inherent instability of the material. The authors have developed several methods that overcome the stability problem and report on the primary photophysics and photochemistry of PSII RC complex suspended in the presence of the non-ionic detergent dodecyl maltoside (DM).

2931 (SERI/CP–236-4396, pp. 162) **An allylic formate ester analogue of retinal as an affinity label for bacteriorhodopsin.** Birnbaum, D. (Brookhaven National Lab., Upton, NY (United States)); Seltzer, S. Solar Energy Research Inst., Golden, CO (United States). [1991]. (CONF-9106213–Absts.: 15. Department of Energy (DOE) solar photochemistry research conference, Snowmass, CO (United States), 2-6 Jun 1991). In *Fifteenth DOE solar photochemistry research conference.* 165p. Order Number DE91002165. Source: OSTI; NTIS.

In an attempt to label the nucleophilic group responsible for catalyzing dark cis-trans isomerization of bacteriorhodopsin's retinal, a highly reactive allylic formate ester analogue of the retinal was synthesized and its interaction with bacterioopsin was studied. The analogue has a half-life of 0.9 minutes in aqueous neutral buffer but is stable for hours in the apomembrane in the same buffer. Reactions of this analogue in the apomembrane have been investigated.

2932 (SERI/CP–236-4396, pp. 163) **Hole burning studies of excited-state structure and dynamics in bacterial antenna systems.** Small, G.J. (Ames Lab., IA (United States)); Johnson, S.G.; Reddy, N.R.S. Solar Energy Research Inst., Golden, CO (United States). [1991]. (CONF-9106213–Absts.: 15. Department of Energy (DOE) solar photochemistry research conference, Snowmass, CO (United States), 2-6 Jun 1991). In *Fifteenth DOE solar photochemistry research conference.* 165p. Order Number DE91002165. Source: OSTI; NTIS.

In recent years, spectral hole burning spectroscopy has been shown to be a powerful, high resolution frequency domain technique for probing the excited state structure, electron-protein phonon coupling, dynamics and heterogeneity of chlorophylls in the light harvesting and reaction center complexes of photosynthetic units. Here, the authors focus on the utilization of nonphotochemical hole burning to explore excitonic interactions and relaxation times of bacteriochlorophyll in protein complexes of the antenna of P. aestuarii and Rb. sphaeroides.

2933 (SERI/CP–236-4396, pp. 166) **Quinones in photosynthetic electron transport.** Thurnauer, M.C. (Argonne National Lab., IL (United States)); Snyder, S.W.; Norris, J.R.; Rustandi, R.R.; Biggins, J. Solar Energy Research Inst., Golden, CO (United States). [1991]. (CONF-9106213–Absts.: 15. Department of Energy (DOE) solar photochemistry research conference, Snowmass, CO (United States), 2-6 Jun 1991). In *Fifteenth DOE solar photochemistry research conference.* 165p. Order Number DE91002165. Source: OSTI; NTIS.

Taking their cue from the bacterial reaction center protein where the primary electron donor is a bacteriochlorophyll dimer and the first stable electron acceptor is ubiquinone acceptor, many model photosynthetic systems utilize porphyrin donors and quinone acceptors. However, in order to understand the role of quinones in electron transport, and how to best use them in modeling photosynthesis, several questions arise. For example, do quinones participate in electron transport in all photosynthetic systems, and, where they do, what are the structural and energetic requirements for a given quinone to work efficiently in a particular photosynthetic system? Photosystem II of green plants is similar to the bacterial photosystem in having a chlorophyll donor and a plastoquinone acceptor. The role of the quinone, vitamin K_1 (K_1), found in plant Photosystem I (PSI) is not as well-defined. Even less is known about the part quinones play in electron transport in the green sulfur photosynthetic bacteria which are considered to be precursors to plant PSI. The authors are investigating the roles of K_1 in the PSI primary reactions and of quinones in the green sulfur bacteria.

2934 (SERI/CP–236-4396, pp. 167) **Mechanisms for assembly of energy and electron transfer complexes with photosynthetic proteins.** Tiede, D.M. (Argonne National Lab., IL (United States)); Gaines, G.L.; Smith, U.; Thiyagarajan, P.; Gunner, M. Solar Energy Research Inst., Golden, CO (United States). [1991]. (CONF-9106213–Absts.: 15. Department of Energy (DOE) solar photochemistry research conference, Snowmass, CO (United States), 2-6 Jun 1991). In *Fifteenth DOE solar photochemistry research conference.* 165p. Order Number DE91002165. Source: OSTI; NTIS.

The authors are examining the detailed mechanisms responsible for the spontaneous self-assembly of energy and electron transfer complexes with the bacterial photosynthetic reaction center. The assembly of these complexes is driven by molecular interactions

between different chromophore-binding protein matrices. These chromophore-binding proteins provide a model for the design of self-organizing, wholly synthetic matrices for organic photochemistry.

2935 (SERI/CP–236-4396, pp. 168) **Factors determining stability of bacteriochlorophyll monolayers.** Raser, L.N. (Ames Lab., IA (United States)); Kim, J.H.; Cotton, T.M.; Uphaus, R.A. Solar Energy Research Inst., Golden, CO (United States). [1991]. (CONF-9106213–Absts.: 15. Department of Energy (DOE) solar photochemistry research conference, Snowmass, CO (United States), 2-6 Jun 1991). In *Fifteenth DOE solar photochemistry research conference.* 165p. Order Number DE91002165. Source: OSTI; NTIS.

Study of bacteriochlorophyll a (BChl) in monolayer form requires exact knowledge of the factors which may affect the chemical stability of this compound. Early studies of BChl monolayers indicated that BChl was readily oxidized to e.g. a desvinyl chlorophyll derivative, but no systematic study of the important factors governing BChl has yet appeared. The authors have conducted a study of the stability of BChl and its decomposition products, the most important of which is 2′-desvinyl chlorophyll-a, from conditions in which maximum decomposition was noted.

2936 (SERI/CP–236-4396, pp. 169) **Fourier transform-EPR study of photoinduced electron transfer reactions in micellar solutions.** Levstein, P.R. (Univ. of Massachusetts, Boston (United States)); Ebersole, M.; Van Willigen, H. Solar Energy Research Inst., Golden, CO (United States). [1991]. (CONF-9106213–Absts.: 15. Department of Energy (DOE) solar photochemistry research conference, Snowmass, CO (United States), 2-6 Jun 1991). In *Fifteenth DOE solar photochemistry research conference.* 165p. Order Number DE91002165. Source: OSTI; NTIS.

The formation of redox ions in photoinduced electron transfer reactions can be promoted by solubilizing the reactants in micelles. A judicious choice of surfactants and reactants can optimize the efficiency of forward electron transfer, while the rate of back reaction can be reduced. The efficiency of the reaction and lifetime of the redox ions depends on the relative positions of donor and acceptor molecules in the heterogeneous medium and on the spatial distribution of products. The work presented here concerns the application of FT-EPR in the study of electron transfer from porphyrins to quinones in homogeneous and micellar solutions. The objective of the research is to contribute to the understanding of how the mechanism and dynamics of electron transfer is affected by the heterogeneous medium.

2937 (SERI/CP–236-4396, pp. 170) **Asymmetric photopotentials from polymeric porphyrin films.** Wamser, C.C. (Portland State Univ., OR (United States)); Li, W. Solar Energy Research Inst., Golden, CO (United States). [1991]. (CONF-9106213–Absts.: 15. Department of Energy (DOE) solar photochemistry research conference, Snowmass, CO (United States), 2-6 Jun 1991). In *Fifteenth DOE solar photochemistry research conference.* 165p. Order Number DE91002165. Source: OSTI; NTIS.

Thin polymeric films have been prepared by interfacial polymerization of tetra(p-chlorocarbonylphenyl)porphyrin (TCCPP) in dichloromethane with tetra(p-hydroxyphenyl)porphyrin (THPP) in aqueous base (pH 11 buffer). When placed between transparent ITO electrodes and irradiated with either continuous illumination or a pulsed laser, these films develop directional photopotentials. Maximum photopotentials are currently about 150 mV under conditions of white light illumination. The kinetics of the photopotentials have been studied and two mechanisms identified.

1406 Photovoltaic Power Systems

Refer also to citation(s) 3554

2938 (BNL–47787) **Recycling of cadmium and selenium from photovoltaic modules and manufacturing wastes: A workshop report.** Moskowitz, P.D.; Zweibel, K. (eds.). Brookhaven National Lab., Upton, NY (United States). [1992]. 101p. Sponsored by USDOE, Washington, DC (United States); Electric Power Research Inst., Palo Alto, CA (United States); National Renewable Energy Lab., Golden, CO (United States); Cadmium Council, Inc., Greenwich, CT (United States). DOE Contract AC02-76CH00016. (CONF-9203206–: Recycling of cadmium and selenium from photovoltaic modules and manufacturing wastes, Golden, CO (United States), 11-12 Mar 1992). Order Number DE93002115. Source: OSTI; NTIS; INIS; GPO Dep.

Since the development of the first silicon based photovoltaic cell in the 1950's, large advances have been made in photovoltaic material and processing options. At present there is growing interest in the commercial potential of cadmium telluride (CdTe) and copper indium diselenide (CIS) photovoltaic modules. As the commercial potential of these technologies becomes more apparent, interest in the environmental, health and safety issues associated with their production, use and disposal has also increased because of the continuing regulatory focus on cadmium and selenium. In future, recycling of spent or broken CdTe and CIS modules and manufacturing wastes may be needed for environmental, economic or political reasons. To assist industry to identify recycling options early in the commercialization process, a Workshop was convened. At this Workshop, representatives from the photovoltaic, electric utility, and nonferrous metals industries met to explore technical and institutional options for the recycling of spent CdTe and CIS modules and manufacturing wastes. This report summarizes the results of the Workshop. This report includes: (1) A discussion of the Resource Conservation and Recovery Act regulations and their potential implications to the photovoltaic industry; (2) an assessment of the needs of the photovoltaic industry from the perspective of module manufacturers and consumers; (3) an overview of recycling technologies now employed by other industries for similar types of materials; and, (4) a list of recommendation.

2939 (ENET–9100285/3) **Photovoltaics in Switzerland.** Haeberlin, H. (Ingenieurschule Burgdorf, Burgdorf (CH)). Bundesamt fuer Energiewirtschaft, Bern (Switzerland). 1991. 5p. (In German). Order Number DE93729850. Source: OSTI; NTIS; ENET Administration und Versand, Postfach 142, CH-3000 Bern 6, Switzerland.

Practical profit and cost accounts are created for the production of solar current. Grid-connection of photovoltaic plants, grey energy and yield factor are discussed. figs., tabs., 12 refs.

1409 Solar Thermal Utilization

2940 (DOE/CE/15479–T4) **The Sundyne Solar Cooker: Quarterly report.** Long, J.B. Long (John B.), Sarasota, FL (United States). 23 Nov 1992. 7p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG01-90CE15479. Order Number DE93003303. Source: OSTI; NTIS; GPO Dep.

Problems involved in obtaining the results from a program for user testing of 150 solar cookers in Haitian villages since the coup are detailed.

2941 (ENEL-CRTN-G8–91-01) **Modelling turbolence for thermal analysis of stratified storage tank.** Parrini, F.; Vitale, S.; Castellano, L. Ente Nazionale per l'Energia Elettrica, Milan (Italy). Centro Termica e Nucleare. Sep 1991. 7p. (CONF-910802–7: World congress of the International Solar Energy Society, Denver, CO (United States), 19-23 Aug 1991). Order Number DE93729398. Source: OSTI; NTIS (US Sales Only).

There has been considerable progress in recent years in the development of two and three-dimensional mathematical models for the simulation of the charging of liquid storage tanks of the type employed in solar heating systems. Almost all of the models published are based on the assumption of laminar regime. The first attempt to take into account the effects of turbulence was made by Sha and others (1980), who incorporated a simple eddy diffusivity model. Recently, Lightstone and others (1989) proposed an ingenious application of the turbulent viscosity calculated from the standard jet model. The main reason for these rudimentary approaches is the need to save computing time, that may become a restrictive factor in simulations over seasonal or yearly cycles. In focussing on simple ways of incorporating a K-epsilon approximation with tolerable extra-computational effort, this paper describes the computational procedures which were implemented in the computer code THESTA (Alabiso and others, 1989a).

2942 (ETSU-S–1323) **Air flow modelling of the Gateway II atrium building.** Jones, P.J. (University of Wales Coll. of Cardiff (United Kingdom). Welsh School of Architecture); Whittle, G.E. University of Wales Coll. of Cardiff (United Kingdom). Welsh School of Architecture. 1992. 20p. Contract E/5A/1323/2563. Order Number DE93733558. Source: OSTI; NTIS (US Sales Only).

The work presented in this report is the result of a Computational Fluid Dynamics (CFD) modelling investigation of the Gateway II office building. Results indicated that in winter the basic airflow pattern in the Gateway II atrium for both 'stack' and 'stack and wind' conditions is a clockwise movement of air, which compares well with measured data. There are downdraughts on the east end of the atrium and air speeds are predicted to reach about 0.44 m/s at occupant height on the first floor balcony. Wind effects become important, even at average wind speeds, and should be taken account of in the design of naturally ventilated buildings. The temptation to design for stack effect alone should be guarded against. The results to date indicate that the building performs to a reasonable standard for a naturally ventilated office. The atrium enables the deep plant naturally ventilated offices to achieve an environmental performance equivalent to a standard narrow plan (6m deep) natural ventilated office. (author).

1410 Solar Collectors and Concentrators

Refer also to citation(s) 2917

2943 (SAND–92-1904) **PVUSA EMT-1 ENTECH photovoltaic concentrator module test report.** Hund, T.D. Sandia National Labs., Albuquerque, NM (United States). Sep 1992. 110p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-76DP00789. Order Number DE93004023. Source: OSTI; NTIS; GPO Dep.

A single EMCH concentrator module for the Photovoltaics for Utility Scale Application (PVUSA), Emerging Technologies-1 (EMT-1) program has been electrically and environmentally tested to the requirements in Sandia's SAND86-2743 document "Qualification Tests for Photovoltaic Concentrator Cell Assemblies; and Modules." Module testing was divided into three parts: (1) initial characterization, (2) environmental testing, and (3) supplemental testing. Testing began with module inspection for damage, adequate name plate information, grounding off-axis beam damage, and baseline electrical performance. The included thermal cycling, humidity/freeze cycling, rainwater intrusion, and hail impact, and hi-pot testing. After both thermal cycling and environmental testing, the module was electrically tested. The supplemental testing not required by the Sandia qualification document was conducted for engineering evaluation. These tests included wet insulation resistance measurements and cell temperature measurements after installation of heat sink fin extensions. The test sequence revealed some module deficiencies which include RTV adhesive/sealant problems, high cell temperatures, off-track beam damage, and low wet insulation resistance values.

1420 Heat Storage

Refer also to citation(s) 3502

1440 Legislation and Regulations

Refer also to citation(s) 3554

15 GEOTHERMAL ENERGY

1503 Geothermal Exploration and Exploration Technology

2944 (LBL–32140) **Preliminary reservoir engineering studies of the Miravalles geothermal field, Costa Rica.** Haukwa, C. (Lawrence Berkeley Lab., CA (United States)); Bodvarsson, G.S. Lippmann, M.J.; Mainieri, A. Lawrence Berkeley Lab., CA (United States). Jan 1992. 12p. Sponsored by Agency for International Development, Washington, DC (United States). DOE Contract AC03-76SF00098. (CONF-920119–5: 17. workshop on geothermal reservoir engineering, Stanford, CA (United States), 29-31 Jan 1992). Order Number DE93000631. Source: OSTI; NTIS; GPO Dep.

The Earth Sciences Division of Lawrence Berkeley Laboratory in cooperation with the Instituto Costarricense de Electricidad is conducting a reservoir engineering study of the Miravalles geothermal field, Costa Rica. Using data from eight exploration wells a two-dimensional areal, natural-state model of Miravalles has been developed. The model was calibrated by fitting the observed temperature and pressure distributions and requires a geothermal upflow zone in the northern part of the field, associated with the Miravalles volcano and an outflow towards the south. The total hot (about 260°C) water recharge is 130 kg/s, corresponding to a thermal input of about 150 MWt. On the basis of the natural-state model a two-dimensional exploitation model was develope. The field has a production area of about 10 km^2, with temperatures exceeding 220°C. The model indicated that power generation of 55 MWe can be maintained for 30 years, with or without injection of the separated geothermal brine. Generation of 110 MWe could be problematic. Until more information becomes available on the areal extent of the field and the properties of the reservoir rocks, especially their relative permeability characteristics, it is difficult to ascertain if 110 MWe can be sustained during a 30-year period.

1505 Economic, Industrial, and Business Aspects

2945 (DOE/ID/12850–5) **National Geothermal Association Trade Mission to Central America.** National Geothermal Association, Davis, CA (United States). Oct 1992. 58p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG07-89ID12850. Order Number DE93002272. Source: OSTI; NTIS; INIS; GPO Dep.

The United States (US) geothermal industry, the world's most technically proficient, has been unable to achieve penetration into the markets of the developing nations. This report details the findings of an industry Trade Mission to Central America, tasked with determining the reasons for this shortfall and with developing a US industry geothermal export strategy designed to achieve immediate and long-term export benefits.

1506 Environmental Aspects

Refer also to citation(s) 2946

1508 Geothermal Power Plants

2946 (DOE/ID/12850–6) **Documentation of the status of international geothermal power plants and a list by country of selected geothermally active governmental and private sector entities.** National Geothermal Association, Davis, CA (United States). Oct 1992. 378p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG07-89ID12850. Order Number DE93002273. Source: OSTI; NTIS; INIS; GPO Dep.

This report includes the printouts from the International Geothermal Power Plant Data Base and the Geothermally Active Entity Data Base. Also included are the explanation of the abbreviations used in the power plant data base, maps of geothermal installations by country, and data base questionnaires and mailing lists.

16 TIDAL AND WAVE POWER

1607 Tidal Power Plants

Refer also to citation(s) 2909

17 WIND ENERGY

1701 Resources and Availability (Climatology)

2947 (PNL-SA–21181) **The coupling of synoptic and valley winds in the Tennessee Valley.** Doran, J.C.; Whiteman, C.D. Pacific Northwest Lab., Richland, WA (United States). Sep 1992. 17p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. (CONF-9209163–4: 6. American Meteorological Society conference on mountain meteorology, Portland, OR (United States), 29 Sep - 2 oct 1992). Order Number DE93001559. Source: OSTI; NTIS; GPO Dep.

The interaction of winds in a valley with the winds above the valley is of interest for both practical and theoretical reasons. For example, the forecasting of conditions affecting air quality,, emergency preparedness, or aerial spraying of pesticides requires the ability to relate local valley circulations to ambient synoptic conditions. While empirically derived relationships may be useful, it is also desirable to develop an understanding of the mechanisms responsible for the observed behavior. In this paper we combine results from analyses of measurements and model-generated data to provide insight into factors affecting the climatology of the winds in the Tennessee Valley. We discuss four mechanisms that can determine the behavior of winds in a valley. The conditions can be illustrated in terms of the expected joint frequency distributions of the surface and geostrophic winds.

1706 Wind Energy Engineering

Refer also to citation(s) 2959

2948 (DOE/CH/10289–T1) **Cooperative field test program for wind energy systems: Effects of precipitation on wind turbine performance: Detailed test plan and quality assurance plan.** Pacific Wind Energy, Corvallis, OR (United States). 6 Jan 1986. 28p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FC02-86CH10289. Order Number DE93000707. Source: OSTI; NTIS; GPO Dep.

The purpose of this research is to examine the effect of precipitation on wind turbine performance. This study will be conducted at the Whisky Run windfarm on the southern Oregon coast. Precipitation has been shown to cause significant degradation in the performance of the MOD-O wind turbine by Corrigan and DeMiglio (1985), who found performance reductions of up to 20% for light rainfall, 30% for moderate rainfall and 36% for snow and drizzle. There are several penalties due to rainfall, but it appears that most of the performance degradation is due to rain induced roughness. The Whisky Run windfarm receives around 60 inches of rain per year most of which occurs from October through April. During the summer months drizzle is an occasional weather phenomena. Pacific Wind Energy (PWE) and Pacific Power and Light (PP&L) propose to examine the effect of precipitation on wind turbine performance. The Whisky Run windfarm is unique among windfarms because the power sales contract is set up such that the wind farm is considered a research project and the participants have agreed to engage in research that will benefit the industry. PP&L will be providing all of the instrumentation except for the recording rate of rain gage. PWE will be performing the analysis of the data and project management.

2949 (DOE/CH/10311–T1) **Dynamic response testing of the "North Wind 100" Wind Turbine Generator: Final report.** Coleman, C.J.; McNiff, B. Northern Power Systems, Moretown, VT (United States); Solar Energy Research Inst., Golden, CO (United States); Pacific Northwest Lab., Richland, WA (United States). 30 Dec 1987. 104p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FC02-86CH10311 ;AC02-83CH10093. Order Number DE93002945. Source: OSTI; NTIS; GPO Dep.

This report covers the Dynamic Response Testing of the Northern Power Systems "North Wind 100" Wind Turbine Generator. This work was carried out from Oct. 1986 through Dec. 1987 in Altamont Pass. An extensive instrumentation, with over 100 channels of data, was collected on FM tape and processed with SERI Mid-Scale Computer System. The test program objectives, to collect and analyze wind turbine and environmental data was successfully completed. Test program information and reduced data, including operational functions, loads, and dynamic characteristics are presented within this report.

2950 (ETDE-IT–92-77) **Blade pitch control of small wind generator.** Corsi, S. Ente Nazionale per l'Energia Elettrica, Milan (Italy). 1991. 26p. (CONF-9005434–1: Wind turbine control system strategy and problems, London (United Kingdom), 3-4 May 1990). Order Number DE93729406. Source: OSTI; NTIS (US Sales Only).

The paper considers wind generator blade pitch control problems and compares the behaviour of two different blade-pitch control systems. More precisely the dynamic performances of rotor speed and power-output limitation controls of a 50 kW ENEL (Italian Electricity Board)-FIAT wind generator are shown with reference to the original solution adopting hydromechanical actuators, and the more effective new one which employs electromechanical actuators. The study and design of the solutions adopted are presented. Some experimental results on the behaviour of the old control system and the new electromechanical one are also given.

2951 (ETDE-mf–93728759) **Manufacture and testing of low-maintenance wind-energy compact plants of 80 kW under industrial conditions.** IRB-Forschungsbericht. Wobben, A. Forschungszentrum Juelich GmbH (Germany); Informationszentrum Raum und Bau der Fraunhofer-Gesellschaft (IRB), Stuttgart (Germany); Bundesministerium fuer Forschung und Technologie, Bonn (Germany). [1992] 24p. (In German). Contract BMFT 032007D. Order Number DE93728759. Source: OSTI; NTIS (US Sales Only).

This research project involved 5 wind-energy plants with an installed output of 80 kW each to be built. Testing of the zero-series is to verify the functions "availability" and "energy yield". The plants feature a compact design allowing industrial manufacturing to be feasible in wind-energy-system engineering, too. The results prompted to build a new variant which has a 34 m concrete tower and a longer rotorblade for the 80 kW plant which is expected to produce a higher yield in inland applications but also at coast sites. (BWI).

2952 (ETSU-WN–6015) **The theoretical investigation of the impact of control systems on fatigue of wind turbines.** Quarton, D.C. Garrad, Hassan and Partners, Bristol (United Kingdom). 1992. 157p. Order Number DE93733561. Source: OSTI; NTIS (US Sales Only).

The work presented in this report is concerned with the influence of conventional PI/PID closed loop pitch control on the fatigue loads experienced by wind turbine rotors. The mechanism by which such fatigue loads are induced by pitch control is described and illustrated by means of measured data from the WEG MS-1. A well validated theoretical treatment of cyclic and turbulent loading of a wind turbine has been extended to enable prediction of the fatigue damage rates experienced by any configuration of rotor, operating with any conventional configuration of closed loop controller. The extended model has been validated by comparing predictions with measured data from the MS-1. A parametric study has been conducted using the theoretical model. The study has shown that additional low frequency blade fatigue loading is experienced as a result of the pitch control required for attenuation of dominant low frequency power fluctuations. (author).

2953 (ETSU-WN–6042) **The influence of an advanced pitch control algorithm on wind turbine fatigue loads.** Quarton, D.C. Garrad, Hassan and Partners, Bristol (United Kingdom). 1992. 54p. Order Number DE93733562. Source: OSTI; NTIS (US Sales Only).

At present the majority of medium sized commercial wind turbines operate with partial or full span pitch control. This form of control has traditionally involved adjusting the pitch of the blades in order to maintain the power output of the machine at its rated level. This study has been based on an artificial wind turbine configuration adopted by ICU for control design purposes. The theoretical approach taken in the study has enabled rotor and drive train fatigue loads, power quality and pitch actuator duty to be computed for both the ICU classical controller and a well designed PI based control system. The calculations have taken proper account of the turbulent structure of the wind, the structural dynamics of the rotor and tower, and the torsional dynamics of the power train. (author).

2954 (NREL/TP–442-5159) **A discussion of the results of the rainflow counting of a wide range of dynamics associated with the simultaneous operation of adjacent wind turbines.** Kelley, N.; Desrochers, G.; Tangler, J.; Smith, B. National Renewable Energy Lab., Golden, CO (United States). Oct 1992. 9p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC02-83CH10093. (CONF-921049–2: Windpower '92, Seattle, WA (United States), 19-23 Oct 1992). Order Number DE93000016. Source: OSTI; NTIS; GPO Dep.

The objective of this study was to provide a fatigue load comparison between two identical wind turbines employing different rotor designs. One turbine was fitted with a rotor consisting of a set of NREL (SERI) thin-airfoil blades while the other rotor included the original-equipment AeroStar blades. The data discussed are based on sample load populations derived from the rainflow cycle counting of 405, 10-minute records specifically collected over a wide range of inflow turbulence conditions. The results have shown that the statistical structure of the alternating load cycles on both turbines can be described as a mixture of three stochastic processes. We noted a high degree of load distribution similarity between the two turbines, with the differences attributable to either rotor weight or swept area.

2955 (SAND–92-1061C) **Elastic dynamics of a complete wind turbine structure: Theoretical development.** Lobitz, D.W.; Arguello, J.G.; Veers, P.S. Sandia National Labs., Albuquerque, NM (United States). [1992]. 6p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-76DP00789. (CONF-921049–3: Windpower '92, Seattle, WA (United States), 19-23 Oct 1992). Order Number DE93002478. Source: OSTI; NTIS; GPO Dep.

This paper develops a pseodo-linear formulation of the equations of motion for analyzing elastic bodies which undergo large rotations relative to one another with an emphasis on its application to HAWTs. This procedure greatly simplifies the computational aspects of the solution algorithm over the nonlinear alternatives and should yield a significant improvement in computer speed. Additional speed can be achieved by ordering the nodes such that a minimum bandwidth can be realized (leading to approximately 64 multiplications per degree of freedom per solution step). The formulation utilizes a set of nested moving coordinate systems, each of which is loosely tied to one of the elastic bodies such that the displacements in the body relative to its coordinate system remain small. The formulation also includes a scheme for handling the nonlinear geometric stiffness that occurs in the blades as a result of the centrifugal loads in a pseudo-linear fashion.

2956 (SAND–92-1607C) **Power quality measurements on a 500 kW variable speed VAWT.** Newton, S.C. (Sandia National Labs., Albuquerque, NM (United States)); Clark, R.N. Sandia National Labs., Albuquerque, NM (United States). [1992]. 6p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-76DP00789. (CONF-910154–2: 10. American Society of Mechanical Engineers (ASME) wind energy symposium, Houston, TX (United States), 20-24 Jan 1991). Order Number DE93002459. Source: OSTI; NTIS; INIS; GPO Dep.

Power quality tests have been conducted with the DOE/Sandia 34-m VAWT Test Bed located at the USDA Agricultural Research Service in Bushland, Texas. These tests were conducted in conjunction with the local electric utility, Southwestern Public Service Company, to determine the effects of the turbine on the 13.2 kV utility line. The Test Bed consists of a 34-m diameter wind turbine coupled, via a mechanical transmission, to a 500 kW electric synchronous motor/generator. The motor/generator is controlled by a load-commutated inverter (LCI) variable-speed motor drive. This AC-DC-AC LCI system converts the variable output voltage and frequency of the motor/generator to dc and then converts the dc to the voltage and frequency of the utility line. The LCI is also used as a variable-speed motor drive to rotate the turbine up to operating speed. The turbine is connected to a feeder line that is 25 km from the first substation. The line is one branch of three feeders that are common to the same substation breaker. The total peak load on this feeder is approximately 1.4 MW. The minimum penetration of the turbine at rated power into the feeders is 35% with the possibility existing of penetration into the utility transmission grid. This "soft line" is an ideal configuration to test the effects that a wind generating system may have on a remote or isolated utility line. As a result of this testing, the harmonic distortion present before and after the LCI isolation transformer has been quantified and the damping effect the isolation transformer has on the distortion has been observed. Also, the operating conditions that produce the maximum distortion have been determined. The data taken comparing power factor with rotor torque and generator speed indicate that the LCI's power factor increases with rotor torque but is limited by the speed of the generator.

2957 (WAESD-TN–87-0028) **The dynamic loads tests of the Westinghouse 600 kW wind turbine.** Snow, A.L.; Heberling, C.F. II. Westinghouse Electric Corp., Pittsburgh, PA (United States). Advanced Energy Systems Div. Nov 1987. 240p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FC02-86CH10296. Order Number DE93002137. Source: OSTI; NTIS; GPO Dep.

A 600 kW Westinghouse wind turbine located on the North Shore of Oahu, Hawaii has been used to document the loads of service for an intermediate size wind turbine. This report documents the instrumentation, data acquisition system, data gathering periods, calibration, and the initial assessment of the data. These data will permit aeroelastic design methods to be calibrated to actual service loadings of medium size, up-wind, teetered hub, horizontal axis wind turbines.

1707 Health and Safety

2958 (ECN-C–92-018) **Reliability analysis methods for wind turbines: Task 1 of the project: Probabilistic safety assessment for wind turbines.** Rademakers, L.W.M.M. (Netherlands Energy Research Foundation, Petten (Netherlands)); Blok, B.M.; Van den Horn, B.A.; Jehee, J.N.T.; Seebregts, A.J.; Van Otterloo, R.W. Netherlands Energy Research Foundation (ECN), Petten (Netherlands). Jun 1992. 103p. Contract NOVEM 24.710/3010;Contract CEC/DG-12 JOUR-CT90-0106;Pro Order Number DE92557247. Source: OSTI; NTIS (US Sales Only).

The aim of the title project is to search for and to develop a methodology that takes advantage of probabilistic reliability techniques, and that can be applied on a complementary basis to existing rules. The methodology implies: (1) to enable the industry to make a well-balanced design; (2) to give the certifying bodies the opportunity to assess the safety and reliability of wind turbines in addition to the deterministic design rules; and (3) to give insight into the amount of conservatism of the present design regulations and of the presented margins. In this phase of the project, a survey of safety and reliability analysis methods is presented. Considering the objectives of this project and the particular characteristics of the analysis methods a suitable set of methods is selected for performing a case study on the Lagerwey 15/75 wind turbine in the next phase of the project. The methods include: System Reliability (such as Safety Audits, Failure Mode Effect and Criticality Analysis, and Fault Tree Analysis) and Structural Reliability. 8 figs., 9 tabs., 2 apps., 31 refs.

2959 (ECN-C–92-039) **Development of the IEC-standard for wind turbines: Report of the 1991 activities.** Van Hulle, F. Netherlands Energy Research Foundation (ECN), Petten (Netherlands). Jun 1992. 127p. (In English, Dutch). Contract NOVEM 24.201-1060;Project ECN 4012. Order Number DE92557283. Source: OSTI; NTIS (US Sales Only).

The Netherlands Energy Research Foundation (ECN) in Petten, Netherlands, participated in the working groups of IEC-TC88 (International Electrotechnical Commission-Technical Committee). These working groups develop an international standard 'Safety of Wind Turbine Generator Systems'. Working group 1 (Safety Philosophy) completed the activities in 1991. Working group 2 (Engineering Integrity) achieved considerable progress in four meetings. It is expected that this working group will complete a draft in the first part of 1992. In this report an overview is given of the activities and the results sofar. Also it is indicated to what extent the draft standard will follow the current Dutch criteria, and a description is given of the follow-up activities. 1 tab., 2 refs., 8 apps.

20 FOSSIL-FUELED POWER PLANTS

2001 Power Plants and Power Generation

Refer also to citation(s) 2552, 2585, 2586, 2587, 2588, 2589, 2590, 2591, 3583, 3584, 3585, 3586, 3947

2960 (CONF-921004–2) **Application of numerical modeling in a clean-coal demonstration project.** Latham, C.E. (Babcock and Wilcox Co., Alliance, OH (United States). Research and Development Div.); Laursen, T.A.; Bellanca, C.; Duong, H. Babcock and Wilcox Co., Alliance, OH (United States). Research and Development Div. [1992]. 13p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FC22-91PC90545. From International joint power generation conference; Atlanta, GA (United States); 18-22 Oct 1992. Order Number DE92041197. Source: OSTI; NTIS; GPO Dep.

Currently, utility boilers equipped with cell burners comprise 13% of pre-NSPS coal-fired generating capacity. The cell burner rapidly mixes the pulverized coal and combustion air resulting in rapid combustion and high NO_x generation. A US Department of Energy (DOE) Clean-Coal Technology Demonstration project is underway at Dayton Power & Light's J. M. Stuart Station to demonstrate the Low-NO_x Cell™ burner (LNCB™) on a 605-MWe utility boiler originally equipped with cell burners. The LNCB™ is designed to reduce NO_x emissions by delaying the mixing of the coal and the combustion air without boiler pressure part modifications. Preliminary post-retrofit testing results showed unexpectedly high carbon monoxide (CO) and hydrogen sulfide (H_2S) concentrations below the lowest burner row. The substoichiometric operation of the lowest burner row caused the relatively high concentrations in the lower furnace. Babcock & Wilcox's flow, combustion, and heat transfer models were used to predict the CO concentrations in the lower furnace. The predictions were compared to field measurements for three different operating conditions. Based on this validation, the models were used to evaluate several methods for mitigating the CO concentrations. The results of this analysis are presented and discussed. The most attractive alternative was selected and will be implemented during the spring of 1992. The effectiveness of the new alternative will be available when the installation is complete and testing resumes.

2961 (DOE/MC/27363–93/C0076) **Status of Tampa Electric Company IGCC Project.** Jenkins, S.D. Tampa Electric Co., FL (United States). [1992]. 15p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FC21-91MC27363. (CONF-920979–2: 1. annual clean coal technology conference, Cleveland, OH (United States), 22-24 Sep 1992). Order Number DE93001482. Source: OSTI; NTIS; GPO Dep.

Tampa Electric Company will utilize Integrated Gasification Combined Cycle technology for its new Polk Power Station Unit #1. The project is partially funded under the Department of Energy Clean Coal Technology Program Round III. This paper describes the technology to be used, process details, demonstration of a new hot gas clean-up system, and the schedule, leading to commercial operation in July 1996.

2962 (DOE/METC/C–93/7034) **Sulfur capture mechanisms.** Siriwardane, R.V.; Poston, J.A.; Woodruff, S.D. Department of Energy, Morgantown, WV (United States). Morgantown Energy Technology Center. [1992]. 10p. Sponsored by USDOE, Washington, DC (United States). (CONF-920951–3: US Department of Energy contractors review meeting on gasification and gas stream cleanup systems, Morgantown, WV (United States), 15-17 Sep 1992). Order Number DE93001383. Source: OSTI; NTIS; GPO Dep.

The Morgantown Energy Technology Center is currently involved in developing high-temperature cleanup for the integrated gasification combined cycle process. Solid sorbents are being employed to remove sulfur-bearing gases. Therefore, it is important to know the reaction mechanisms and kinetics of the interactions of the sulfur-bearing gases with sorbent materials, and the changes in elemental composition during reactions in order to develop novel sorbents and/or to improve existing sorbents. In our previous work (1,2,3) the mechanisms of the reactions of CaO with SO_2/O_2, zinc titanate with H_2S/CO and H_2 and elemental changes in zinc copper ferrite during heating were investigated. It was found that the CaO reaction proceeds via $CaSO_3$ an intermediate while in the zinc titanate reaction $ZnSO_4$ was formed as an intermediate. Migration of copper to the surface and presence of copper in the +1 state was observed in zinc copper ferrite at 823K. In the present work, the characterization of fresh, sulfided and regenerated zinc titanate sorbents, and the mechanism of sulfate formation during regeneration of zinc sulfide were investigated. X-Ray photoelectron spectroscopy (XPS), Scanning electron microscopy/Electron dispersive analysis (SEWEDS), and Fourier transform infra-red spectroscopy (FTIR) were used to analyze intermediates and products during the reaction.

2963 (DOE/METC/C–93/7035) **TGA studies on supported sorbents at elevated pressures: Capture mechanisms.** Gasper-Galvin, L.D. (Department of Energy, Morgantown, WV (United States). Morgantown Energy Technology Center); Gupta, R.P. Department of Energy, Morgantown, WV (United States). Morgantown Energy Technology Center. [1992]. 22p. Sponsored by USDOE, Washington, DC (United States). (CONF-920951–4: US Department of Energy contractors review meeting on gasification and gas stream cleanup systems, Morgantown, WV (United States), 15-17 Sep 1992). Order Number DE93001382. Source: OSTI; NTIS; GPO Dep.

The objective of the supported sorbents research at the Morgantown Energy Technology Center (METC) is to develop a hot gas desulfurization sorbent which will have superior attrition resistance, higher temperature capability, and increased sulfidation/regeneration cycle life, as compared to bulk metal oxide sorbents such as zinc ferrite and zinc titanate. Previous investigations of zeolite supported sorbents at METC have been conducted at 205 kPa (15 psig). The purpose of this study was to use thermogravimetric analysis (TGA) to obtain information on the performance of zeolite supported sorbents at a pressure which is similar to that expected in a commercial Integrated Gasification Combined Cycle (IGCC) plant. The following conclusions can be drawn from this study: (1) The pressure significantly affected the desulfurization reactivity. Generally, the desulfurization reactivity increased with an increase in the pressure. (2) Sulfate formation occurred to a greater extent at higher pressures. (3) The hydrothermal stability of the SP-115 zeolite that was used as a support was questionable, especially at high pressures. However, it appeared that the presence of metal oxides helped to stabilize the zeolite against degradation by the high pressure steam environment. (4) The combination of copper, molybdenum, and manganese oxides appeared to have a good synergism in enhancing the sorbent reactivity.

2964 (DOE/PC/90275–T21) **Development of an advanced high efficiency coal combustor for boiler retrofit: Quarterly report, November 1986–January 1987.** Rini, M.J. (Combustion Engineering, Inc., Windsor, CT (United States)); LaFlesh, R.C.; Beer, J.M.; Togan, M.A.; Yu, T.U.; McGowan, J.G. Combustion Engineering, Inc., Windsor, CT (United States); Massachusetts Inst. of Tech., Cambridge, MA (United States). 6 May 1987. 14p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC22-86PC90275. Order Number DE93000879. Source: OSTI; NTIS; GPO Dep.

During the quarter from October 1986 to January 1987 the following technical progress was made: (1) Initiated a literature study focusing on optimized burner aerodynamics and design methodologies for high efficiency swirl generation devices, (2) Completed design of Swirler Test Facility (STF) to be used for comparative swirler evaluations, and (3) Initiated facility preparation at MIT for thermal atomization studies and high shear viscosity measurements.

2965 (ENEL-CRTN-G11–89-10) **Fracture toughness testing of sub-sized and weld-renconstructed specimens.** Bicego, V.; Lucon, E.; Ragazzoni, S. Centro Informazioni Studi Esperienze (CISE), Milan (Italy); Ente Nazionale per l'Energia Elettrica, Milan (Italy). Centro Termica e Nucleare. 1989. 32p. (CONF-8910199–2: European symposium on elastic-plastic fracture mechanics (EPFM), Freiburg (Germany), 9-12 Oct 1989). Order Number DE93729462. Source: OSTI; NTIS (US Sales Only).

Mechanical tests on specimens directly sampled from fossil fuel power plants are experiencing increasing popularity as a useful non-destructive method to assess the integrity of components operating at high temperatures. Mainly due to limitations in material availability, several problems exist in obtaining valid data from the tests and non-standard test procedures have to be considered and validated. This paper reports the results of studies involving linear elastic (LEFM), elasto-plastic (EPFM) and Charpy tests performed on a number of steels. Two different types of non-conventional specimens, namely electron beam welded composite and sub-sized specimens were utilized. Two different reconstruction geometries were considered for the composite specimens, and a miniature disk-shaped (D = 16 mm) geometry was tried for the sub-sized specimens. EPFM test techniques included a multi-specimen procedure, unloading compliance and potential drop. Agreement between the results of the EPFM tests on composite and on standard specimens was found. Large discrepancies were observed in Charpy data and in LEFM data for one particular reconstruction geometry. The reasons seem to be attributable to inaccurate welding, excessive heat embrittlement of the material in the core of the small Charpy specimens, and large residual stresses in the crack tip zone of the composite CT specimens.

2966 (ENEL-CRTN-T6–91-12) **ESCA: Expert system for cycle chemistry on-line control during power plant start-up.** Riccardi, L.; Savoldelli, P.; Sigon, F. Centro Informazioni Studi Esperienze (CISE), Milan (Italy); Ente Nazionale per l'Energia Elettrica, Milan (Italy). Centro Termica e Nucleare. 1991. 13p. (CONF-9105395–1: Workshop on cycle chemistry in fossil fuel power plants, Copenhagen (Denmark), 21-22 May 1991). Order Number DE93729439. Source: OSTI; NTIS (US Sales Only).

The application and development of an expert system for cycle chemistry control and management in a fossil-fired power plant during load transients is evaluated. The prototype architecture, first developed for plant start-up conditions, is presented and discussed with reference to an ENEL (Italian Electricity Board) 320 MW Unit with a drum boiler and AVT (All Volatile Treatment) conditioning (Fusina 4 station).

2967 **Regenerable activated bauxite adsorbent alkali monitor probe.** Lee, S.H.D. To Dept. of Energy. 22 Jan 1991. USAA patent application 7-643,31. 17p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-31109-ENG-38. Order Number DE93001989. Source: OSTI; NTIS; GPO Dep.

This invention relates to a regenerable activated bauxite adsorber alkali monitor probe for field applications to provide reliable measurement of alkali-vapor 5 concentration in combustion gas with special emphasis on pressurized fluidized-bed combustion (PFBC) off-gas. More particularly, the invention relates to the development of a easily regenerable bauxite adsorbent for use in a method to accurately determine the alkali-vapor content of PFBC 10 exhaust gases.

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2968 (DOE/MC/10637–3134) **Enhanced flue gas conditioning study: Final report for Task 7.20.** Miller, S.J.; Laudal, D.L. North Dakota Univ., Grand Forks, ND (United States). Energy and Environmental Research Center. Nov 1991. 255p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FC21-86MC10637. Order Number DE93000218. Source: OSTI; NTIS; GPO Dep.

Many electrostatic precipitators (ESPS) do not achieve acceptable particulate removal efficiencies because of high-resistivity ash. One method to improve ESP performance is to employ chemical conditioning agents to reduce fly ash resistivity. Widely used agents include sulfur trioxide (SO_3) and ammonia, which are sometimes used simultaneously. For some fly ashes, that have a low affinity for SO_3, conditioning with SO_3 alone is not adequate to reduce resistivity without excessive amounts of SO_3 exiting the stack. In such cases, the use of ammonia in addition to SO_3 may reduce the amount of required SO_3 and prevent the emission of excess SO_3 out of the stack. The general objective of the work was to test enhanced flue gas conditioning methods to improve the performance of ESPS. Specific objectives were to (1) verify the relationship between the required SO_3 injection rates to maintain the desired fly ash resistivity and temperature for four coals, (2) verify that dual conditioning with both ammonia and SO_3 promotes SO_3 utilization and allows for resistivity modification with moderate SO_3 injection rates, and (3) verify the effectiveness and practicality of an enhanced flue gas conditioning (EFGC) method. The EFGC method is a proprietary development of Wahlco, Inc.

2969 (DOE/PC/79796–T28) **Enhancing the use of coals by gas reburning-sorbent injection: Environmental monitoring quarterly report No. 8, April 1–June 30, 1992.** Energy and Environmental Research Corp., Irvine, CA (United States). 27 Jul 1992. 87p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FC22-87PC79796. Order Number DE92041299. Source: OSTI; NTIS; GPO Dep.

Clean Coal Technology implies the use of coal in an environmentally acceptable manner. Coal combustion results in the emission of two types of acid rain precursors: oxides of sulfur (sox) and oxides of nitrogen (NO_x). This Clean Coal Technology project will demonstrate a combination of two developed technologies to reduce both NO_x and SO_x emissions. Gas reburning and calcium based dry sorbent injection. The demonstrations will be conducted on two pre-NSPS utility boilers representative of the US boilers which contribute significantly to the inventory of acid rain precursor emissions. Gas reburning is a combustion modification technique that consists of firing 80–85 percent of the fuel (corresponding to the total heat release) in the lower furnace. Reduction of NO_x to molecular nitrogen (N_2) is accomplished via the downstream injection of the remaining fuel requirement in the form of natural gas (which also reduces the total SO_x emissions). In a third stage, burnout air is injected at lower temperatures in the upper furnace to complete the combustion process without generating significant additional NO_x. Dry sorbent injection consists of injecting calcium based sorbents (such as limestone, dolomite, or hydrated lime) into the combustion products. For sulfation of the sorbent to $CaSO_4$, an injection temperature of about 1230°C is optimum, but calcium-sulfur reactions can also take place at lower temperatures. Thus, the sorbent may be injected at different locations, such as with the burnout air, at the exit from the superheater, or into the ducting downstream of the air heater with H_2O added for humidification. The specific goal of this project is to demonstrate NO_x and SO_x emission reductions of 60 percent and 50 percent, respectively, on two coal fired utility boilers having the design characteristics mentioned above.

2970 (DOE/PC/88914–T5) **Electrochemical abatement of pollutants NO_x and SO_x in combustion exhaust gases employing a solid-oxide electrolyte: Second quarterly report, January 1989–March 1989.** Stevenson, D.A.; Frank, C.W. Stanford Univ., CA (United States). [1989]. 5p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG22-88PC88914. Order Number DE93001342. Source: OSTI; NTIS; GPO Dep.

The role of oxygen vacancies in the conductivity of ESB was studied using such solidstate techniques as differential thermal analysis and x-ray diffraction. A change in the slope of conductivity vs. reciprocal temperature, at ~600°C, indicates two different conductivity regions. The above techniques were used to show that the change in slope is due to an order-disorder transition of the oxygen sublattice. At high temperatures, the oxygen sublattice is disordered resulting in a high mobility of oxygen vacancies and a low apparent activation energy. At low temperatures the oxygen sublattice tends to order, with the vacancies aligning in (111) planes. The higher activation energy in this temperature regime is than due to the extra energy required to free a vacancy from the ordered state. Furthermore, a reversible aging phenomenon in the conductivity of ESB was observed. For ESB annealed in this lower temperature region, the conductivity was observed to decay with time as the oxygen sublattice ordered. Heating above transition point will completely reverse this process by disordering the oxygen sublattice, and returning the conductivity to its initial value.

2971 (DOE/PC/88914–T6) **Electrochemical abatement of pollutants NO_x and SO_x in combustion exhaust gases employing a solid-oxide electrolyte: Fourth quarterly report, July 1989–September 1989.** Stevenson, D.A.; Frank, C.W. Stanford

Univ., CA (United States). [1989]. 3p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG22-88PC88914. Order Number DE93002575. Source: OSTI; NTIS; GPO Dep.

During the fourth quarter of this grant, the major accomplishment concerns the spectroscopic investigation of oxygen vacancies in YSZ and ESB. The nature of electrolytic "blackening" was studied. It was found that the same reduction processes that turn polycrystalline YSZ black turn single crystals orange. Two absorption bands attributable to this orange coloration, 328 and 470 nm, were observed. The 328 nm absorption band agrees with theoretical calculations for an F-center YSZ. Several fluorescence bands were also observed. An excitation band at 302 nm was found to increase in intensity upon reduction of YSZ and the resulting emission at 580 nm was found to have a temperature dependence typical of F-centers. These results are in agreement with the hypothesis of the formation of color-centers upon reduction of YSZ as being responsible for "blackening" and the resulting enhancement of electrocatalytic reactivity.

2972 (DOE/PC/88943–T4) **N_2O formation in combustion systems: Quarterly technical progress report.** Fossil Energy Research Corp., Laguna Hills, CA (United States). Nov 1989. 7p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC22-88PC88943. (QR–7020-3). Order Number DE93002491. Source: OSTI; NTIS; INIS; GPO Dep.

The objective of this project is to characterize N_2O emissions from combustion sources emphasizing N_2O emissions from post-combustion selective gas phase NO_x reduction processes and reburning. The processes to be evaluated include ammonia, urea and cyanuric acid injection and reburning. The project includes pilot-scale testing at two facilities supported by chemical kinetic modeling. Testing will be performed on both a gas-fired plug flow combustor and a pulverized-coal fired combustor. Work performed to date has included the performance of the initial detailed chemical kinetics calculations. These calculations showed that both urea and cyanuric acid produce significant quantities of N_2O, while NH_3 injection produced negligible amounts. These kinetics data support limited test results reported for cyanuric acid and ammonia injection. Laboratory work to evaluate the selective gas phase NO_x reduction processes listed above will begin in the gas-fired facility early in CY 1990. Testing to evaluate reburning at the coal-fired facility is currently planned to be performed in parallel with the testing at the gas-fired facility. Following completion of that work, additional kinetics calculations will be performed.

2973 (DOE/PC/88943–T5) **N_2O formation in combustion systems: Quarterly technical progress report.** Fossil Energy Research Corp., Laguna Hills, CA (United States). Mar 1990. 19p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC22-88PC88943. (QR–7020-4). Order Number DE93002492. Source: OSTI; NTIS; INIS; GPO Dep.

The objective of this project is to characterize N_2O emissions from combustion sources emphasizing N_2O emissions from post-combustion selective gas phase NO_x reduction processes and reburning. The processes to be evaluated include selective noncatalytic NO_x control (ammonia, urea and cyanuric acid injection), and reburning. The project includes pilot-scale testing at two facilities supported by chemical kinetic modeling. Testing is being performed on both a gas-fired plug flow combustor and a pulverized-coal fired combustor. Work performed to date has included the performance of the initial detailed chemical kinetics calculations. These calculations showed that both urea and cyanuric acid produce significant quantities of N_2O, while NH_3 injection produced negligible amounts, These kinetics data support limited test results reported for cyanuric acid and ammonia injection. Laboratory work to evaluate the selective gas phase NO_x reduction processes listed above has begun. Testing to evaluate reburning at the coal-fired facility is being performed in parallel with the testing at the gas-fired facility. Following completion of the test work, additional kinetics calculations will be performed.

2974 (DOE/PC/89653–T5) **Innovative Clean Coal Technology (ICCT): 180 MW demonstration of advanced tangentially-fired combustion techniques for the reduction of nitrogen oxide (NO_x) emissions from coal-fired boilers: Technical progress report, first quarter 1992.** Southern Co. Services, Inc., Birmingham, AL (United States). 20 May 1992. 51p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FC22-90PC89653. Contract C-91-000028. Order Number DE93004361. Source: OSTI; NTIS; GPO Dep.

This quarterly report discusses the technical progress of a US Department of Energy (DOE) Innovative Clean Coal Technology (ICCT) Project demonstrating advanced tangentially-fired combustion techniques for the reduction of nitrogen oxide (NO_x) emissions from a coal-fired boiler. The project is being conducted at Gulf Power Company's Plant Lansing Smith Unit 2 located near Panama City, Florida. The primary objective of this demonstration is to determine the long-term effects of commercially available tangentially-fired low NO_x combustion technologies on NO_x emissions and boiler performance. A target of achieving fifty percent NO_x reduction using combustion modifications has been established for the project. The stepwise approach that is being used to evaluate the NO_x control technologies requires three plant outages to successively install the test instrumentation and the different levels of the low NO_x concentric firing system (LNCFS). Following each outage, a series of four groups of tests are performed. These are (1) diagnostic, (2) performance, (3) long-term, and (4) verification. These tests are used to quantify the NO_x reductions of each technology and evaluate the effects of those reductions on other combustion parameters such as particulate characteristics and boiler efficiency. This technical progess report presents the LNCFS Level III long-term data collected during this quarter. NO_x emissions for each day of long-term testing are presented. The average NO_x emission during long-term testing was 0.39 lb/MBtu at an average load of 155 MW. The effect of the low NO_x combustion system on other combustion parameters such as carbon monoxide, excess oxygen level, and carbon carryover are also included.

2975 (DOE/PC/90292–T7) **Alternative formulations of regenerable flue gas cleanup catalysts: Progress report, March 1, 1992–May 31, 1992.** Mitchell, M.B.; White, M.G. Clark Atlanta Univ., GA (United States). [1992]. 12p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG22-90PC90292. Order Number DE92041246. Source: OSTI; NTIS; GPO Dep.

We have generated higher weight loadings of magnesium on alumina by using a Soxhlet extractor to dissolve sparingly soluble solutes. The solvent is recycled over the alumina support so as to continuously impregnate the support with the metal complex. With this device we are able to obtain loadings of MgO on the alumina up to 0.66 wt%. The precursor samples were examined by diffuse reflectance infrared Fourier transform spectroscopy (DRIFTS) and our results indicate that the complex looses the water of hydration upon adsorption and does not appear to form crystallites. We have shown that $S0_2$ adsorption increases with Mg-loading on the impregnated alun-Linas, with 0.85 additional molecules of $S0_2$ adsorbed for each additional Mg atom (or MgO molecule) on the surface.

2976 (ENEL-CRTN-T6–91-08) **Mechanistic study of poisoning of DeNoxING catalysts by alcali metals.** Ramis, G.; Busca, G.; Bregani, F.; Forzatti, P. Ente Nazionale per l'Energia Elettrica, Milan (Italy). Centro Termica e Nucleare; Genoa Univ. (Italy); Politecnico di Milano, Milan (Italy). 1991. 20p. (CONF-9106410–1: 5. international symposium on catalyst deactivation, Evanston, IL (United States), 14-16 Jun 1991). Order Number DE93729450. Source: OSTI; NTIS (US Sales Only).

This paper reports on the investigation, by FT-IR spectroscopy, of the poisoning of these catalysts by alkali metals. The adsorption and co-absorption of nitrogen oxides and ammonia on model catalysts having compositions and morphologies comparable to those of industrial catalysts were compared with results obtained with K-doped samples. A reaction between ammonia strongly adsorbed in the form of amid species, and gas-phase or weakly adsorbed NO was observed directly at temperatures near 450 degrees K on the undoped materials, with the formation of water as a IR detectable product. The reaction does not occur on the pure support. As expected, the amount of adsorbed ammonia and the strength of this adsorption are strongly decreased by potassium doping. Amid species are no longer detectable. The weak adsorption of ammonia and the lack of its activation in the form of amid species induced by potassium is thought to be the key factor in the poisoning of

these catalysts for the selective catalytic reduction of NOx by alkali metals.

2977 (ORNL/M–2347/V2-Pt.3) **Utility FGD survey, January–December 1989: Volume 2, Design performance data for operating FGD systems: Part 3.** Hance, S.L. (IT Corp., Cincinnati, OH (United States)); McKibben, R.S.; Jones, F.M. Oak Ridge National Lab., TN (United States). Mar 1992. 605p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. Order Number DE93003680. Source: OSTI; NTIS; GPO Dep.

Experimental data for 120 flue gas desulfurization systems of fossil-fuel power plants of US electrical utilities with information on the design and performance. No text–all data.

2978 Method of activating limestone for enhanced capture of sulfur from post combustion gases. Abichandan, J.S.; Holcombe, N.T.; Litka, A.F.; Woodroffe, J.A. To Dept. of Energy. 4 Mar 1991. USAA patent application 7-663,52. 14p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC21-86MC23262. Order Number DE93002010. Source: OSTI; NTIS; GPO Dep.

Calcium based sulfur sorbent is prepared in a highly reactive form for use in removing gaseous sulfur species from coal combustion gases by heating finely divided limestone particles at a temperature of at least 2,000 K for a period of 5 to 50 milliseconds and quenching the particles by bringing them to a temperature below 1,400 K before they become sintered. For application to a coal combustion system, the quenching step may be carried out in the post coal combustion zone along with the reaction of the particles with sulfur. The initial heating step is performed outside of the zone because of the high temperatures required in that step, which would result in decomposition of the calcium-sulfur product.

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Refer also to citation(s) 3686, 3690, 3691, 3692, 3716, 3733

21 NUCLEAR POWER REACTORS AND ASSOCIATED PLANTS

Refer also to citation(s) 3491, 3566

2979 (IAEA-TECDOC–660, pp. 131-137) **Knowledge based management of technical specifications.** Fiedler, U. (Zentralinstitut fuer Kernforschung, Rossendorf (Germany)); Schalm, S.; Pranckeviciute, K. International Atomic Energy Agency, Vienna (Austria). Jul 1992. (CONF-9109435–: Technical committee meeting/workshop on demonstration and review of expert system prototypes, Springfields (United Kingdom), 30 Sep 1991). In *Expert systems in the nuclear industry: Report of a technical committee meeting/workshop held in Springfields, United Kingdom, 30 September - 4 October 1991.* 219p. Order Number DE93606682. Source: OSTI; NTIS (US Sales Only); INIS.

TechSPEX is a knowledge based advisory system for checking the status of a nuclear plant on compliance with the safety limits and the limiting conditions of operation. These prescripts for safe reactor operation exist as textual information. For the purpose of its operational use an explicit representation formalism is introduced. On this basis, various approaches of text retrieval are realized, condition based surveillance and control is supported too. Knowledge editing and verification modules ease the adaption to changing requirements. TechSPEX has been implemented in PROLOG. (author). 6 refs, 3 figs.

2980 (IAEA-TECDOC–660, pp. 139-142) **Probabilistic safety assessment and expert systems.** Rumyantsev, A.N. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow (Russian Federation). Inst. Atomnoj Ehnergii). International Atomic Energy Agency, Vienna (Austria). Jul 1992. (CONF-9109435–: Technical committee meeting/workshop on demonstration and review of expert system prototypes, Springfields (United Kingdom), 30 Sep 1991). In *Expert systems in the nuclear industry: Report of a technical committee meeting/workshop held in Springfields, United Kingdom, 30 September - 4 October 1991.* 219p. Order Number DE93606682. Source: OSTI; NTIS (US Sales Only); INIS.

The modern procedures of event tree and fault tree design and analysis being applied for Probabilistic Safety Assessment (PSA) of Nuclear Power Plants (NPP's), do have much in common with methods of expert system development. "Living" PSA systems may be considered under certain conditions as expert systems for support of NPP personal in safety-oriented decision-making. An effectiveness of implementation of "living" PSA systems and expert systems based on them is very much predetermined by peculiarities of data models and its corresponding DBMS software which requires some additional research efforts and development. (author). 5 refs.

2981 (IAEA-TECDOC–660, pp. 147-161) **Possible roles of neural networks in developing expert systems for the nuclear industry.** Boger, Z. (Israel Atomic Energy Commission, Beersheba (Israel). Nuclear Research Center-Negev). International Atomic Energy Agency, Vienna (Austria). Jul 1992. (CONF-9109435–: Technical committee meeting/workshop on demonstration and review of expert system prototypes, Springfields (United Kingdom), 30 Sep 1991). In *Expert systems in the nuclear industry: Report of a technical committee meeting/workshop held in Springfields, United Kingdom, 30 September - 4 October 1991.* 219p. Order Number DE93606682. Source: OSTI; NTIS (US Sales Only); INIS.

There is an evident need for a reliable expert systems in the nuclear industry, especially in the nuclear reactor safety area. However, the derivation of useful expert rules in complex systems is a difficult and a very time consuming process. The ability of artificial neural networks to learn and generalize from "examples" may be utilized in several ways to help in this task. A recently developing proprietary algorithm analyses the training data and provides good guess for the initial connection weights, as well as to the required number of hidden neurodes. Several application examples in systems that are similar to those encountered in the nuclear industry are presented: Automatic derivation of casual relationships in complex industrial plants and experimental data; Real-time sensor validation and "virtual" instrument creation; Knowledge acquisition from multi-stage processes. The limitations of the Neural Network based models are discussed, especially the one relating to the (fortunate) non-availability of real examples for teaching of major fault situations in nuclear reactors. The development of powerful simulators of nuclear power stations may help to overcome this limitation. The measurements and alarms patterns of a simulated fault may be learned by the Neural Network and used for alarm management and generation of expert rules for quick fault detection. 41 refs, 8 figs, 2 tabs.

2982 (IAEA-TECDOC–660, pp. 197-204) **A PC based program for the support of a safety analysis expert.** Stritar, A. (Institut Jozef Stefan, Ljubljana (Yugoslavia)); Mavko, B.; Salamun, I. International Atomic Energy Agency, Vienna (Austria). Jul 1992. (CONF-9109435–: Technical committee meeting/workshop on demonstration and review of expert system prototypes, Springfields (United Kingdom), 30 Sep 1991). In *Expert systems in the nuclear industry: Report of a technical committee meeting/workshop held in Springfields, United Kingdom, 30 September - 4 October 1991.* 219p. Order Number DE93606682. Source: OSTI; NTIS (US Sales Only); INIS.

A computer program DrALF for the postprocessing of RELAP5 results is described. Results may be presented in two different ways, as a set of graphs and as a number of small graphical windows with time history graphs positioned over the stationary background picture. The picture presents the simulation process in two or three dimensions. Calculated results with RELAP5 code have to be transferred from the mainframe to the personal computer as an ASCII file and then converted into more compact format. The background picture has to be prepared with the AutoCAD general purpose drafting software. DrALF is being successfully used for the analysis of results of the RELAP5 code, used in the nuclear industry for the accident and transient simulation. (author). 1 ref., 4 figs.

2101 Power Reactors, Nonbreeding, Light-Water Moderated, Boiling Water Cooled

Refer also to citation(s) 3079, 3296, 3302, 3315, 3316, 3317, 3318, 3319, 3320, 3321, 3322, 3323, 3324, 3325, 3326, 3327, 3328, 3329, 3330, 3331, 3333, 3334, 3335, 3336, 3338, 3339, 3340, 3341, 3342, 3343, 3344, 3345, 3346, 3347, 3348, 3349, 3350, 3352, 3353, 3354, 3355, 3356, 3357, 3358, 3359, 3361, 3362, 3363, 3364, 3365, 3366, 3367, 3368, 3369, 3370, 3371, 3378, 3379, 3380, 3381, 3382, 3385, 3387, 3388, 3389, 3390, 3391, 3392, 3393, 3394, 3395, 3396, 3400, 3402, 3405, 3406, 3408, 3409, 3413, 3415, 3417, 3420, 3421, 3422, 3424, 3425, 3426, 3427, 3428, 3429, 3430, 3432, 3433, 3441, 3444

2983 (BNL-NUREG–47960) **Performance characterization of isolation condenser of SBWR.** Khan, H.J.; Rohatgi, U.S. Brookhaven National Lab., Upton, NY (United States). [1992]. 26p. Sponsored by Nuclear Regulatory Commission, Washington, DC (United States). DOE Contract AC02-76CH00016. (CONF-921102–25: Joint American Nuclear Society (ANS)/European Nuclear Society (ENS) international meeting on fifty years of controlled nuclear chain reaction: past, present, and future, Chicago, IL (United States), 15-20 Nov 1992). Order Number DE93001949. Source: OSTI; NTIS; INIS; GPO Dep.

A systematic study of the performance of the Isolation Condenser (IC) for a conceptual design of SBWR is presented. The objective of the IC is to passively remove heat and control the pressure variation in the Reactor Pressure Vessel (RPV). According to the observed trends, the IC cooling capacity and condensate flow can independently influence the ultimate performance of the IC. The transient pressure profile for the IC reaches different equilibrium values for each of the cases analyzed. The absolute magnitude of these values are a function of the cooling capacity and flow rates. With appropriate control of the liquid flow loss coefficients, the performance of the IC can be well predicted. Due to the lack of useful data, this study is limited to the numerical simulation of the IC.

2984 (CDTN-DETR-NT–249/89) **Evaluation of tests in 4x4 assemblies carried out in Columbia University.** Pedron, M.Q. Centro de Desenvolvimento da Tecnologia Nuclear (CDTN), Belo Horizonte, MG (Brazil). 27 Apr 1989. 32p. (In Portuguese). Order Number DE93607699. Source: OSTI; NTIS (US Sales Only); INIS.

Tests in 4x4 assemblies with BWR characteristics carried out in Columbia University are analysed, using the PANTERA-1P computer code. The experiments aim for measuring fluid, flow and enthalpies in exits of two subchannels, the coldest and hottest using iso kinetic sampling method. (M.C.K.).

2985 (INIS-BR–2954) **Analysis of a BWR direct cycle forced circulation power plants operation.** Andrade, G.G. de. Universidade Federal, Rio de Janeiro, RJ (Brazil). Coordenacao dos Programas de Pos-graduacao de Engenharia. 1973 104p. (In Portuguese). Order Number DE93607701. Source: OSTI; NTIS (US Sales Only); INIS.

First, it is established a general view over the operational problems of the BWR direct cycle forced circulation power plants, and then it is analysed the possibility of the utilization of the energy purged from the turbine as an additional energy for the electrical generation. To simulate the BWR power plant and to obtain the solution of the mathematical model it was developed a computer code named ATOR which shows the feasibility of the proposed method. In this way it is shown the possibility to get a better maneuvering allowance for the BWR power plant whenever it is permitted a convenient use of the vapor extracted from the turbine for the feedwater pre-heaters of the reactor. (author).

2986 (NUREG–1433-Vol.1) **Standard Technical Specifications, General Electric plants, BWR/4: Volume 1, Specifications.** Nuclear Regulatory Commission, Washington, DC (United States). Div. of Operational Events Assessment. Sep 1992. 398p. Sponsored by Nuclear Regulatory Commission, Washington, DC (United States). Source: OSTI; NTIS; INIS; GPO.

This NUREG contains improved Standard Technical Specifications (STS) for General Electric Plants, BWR/6, and documents the positions of the Nuclear Regulatory Commission based on the BWR Owners Group's proposed STS. This document is the result of extensive technical meetings and discussions among the NRC staff, the Nuclear Steam Supply System (NSSS) Owners Groups, the NSSS vendors, and the Nuclear Management and Resources Council (NUMARC). The improved STS were developed based on the criteria in the interim Commission Policy Statement on Technical Specification Improvements for Nuclear Power Reactors, dated February 6, 1987. The improved STS will be used as the basis for individual nuclear power plant licensees to develop improved plant-specific technical specifications. This report contains three volumes. This document Volume 1 contains the Specifications for all chapters and sections of the improved STS. Volume 2 contains the Bases for Chapters 2.0 and 3.0, and Sections 3.1–3.3 of the improved STS. Volume 3 contains the Bases for Sections 3.4–3.10 of the improved STS.

2987 (NUREG–1433-Vol.2) **Standard Technical Specifications, General Electric plants, BWR/4: Volume 2, Bases (Sections 2.0–3.3).** Nuclear Regulatory Commission, Washington, DC (United States). Div. of Operational Events Assessment. Sep 1992. 332p. Sponsored by Nuclear Regulatory Commission, Washington, DC (United States). Source: OSTI; NTIS; INIS; GPO.

This NUREG contains improved Standard Technical Specifications (STS) for General Electric Plants, BWR/4, and documents the positions of the Nuclear Regulatory Commission based on the BWR Owners Group's proposed STS. This document is the result of extensive technical meetings and discussions among the NRC staff, the Nuclear Steam Supply System (NSSS) Owners Groups, the NSSS vendors, and the Nuclear Management and Resources Council (NUMARC). The improved STS were developed based on the criteria in the interim Commission Policy Statement on Technical Specification Improvements for Nuclear Power Reactors, dated February 6, 1987. The improved STS will be used as the basis for individual nuclear power specifications. This report contains three volumes. This document, Volume 2, contains the Bases for Chapters 2.0 and 3.0, and Sections 3.1–3.3 of the improved STS.

2988 (NUREG–1434-Vol.3) **Standard Technical Specifications, General Electric Plants, BWR/6: Volume 3, Bases (Sections 3.4-3.10).** Nuclear Regulatory Commission, Washington, DC (United States). Div. of Operational Events Assessment. Sep 1992. 425p. Sponsored by Nuclear Regulatory Commission, Washington, DC (United States). Source: OSTI; NTIS; INIS; GPO.

This NUREG contains improved Standard Technical Specifications (STS) for General Electric Plants, BWR/4, and documents the positions of the Nuclear Regulatory Commission based on the BWR Owners Group's proposed STS. This document is the result of extensive technical meetings and discussions among the NRC staff, the Nuclear Steam Supply System (NSSS) Owners Groups, the NSSS vendors, and the Nuclear Management and Resources Council (NUMARC). The improved STS were developed based on the criteria in the interim Commission Policy Statement on Technical Specification Improvements for Nuclear Power Reactors, dated February 6, 1987. The improved STS will be used as the basis for individual nuclear power plant licensees to develop improved plant-specific technical specifications. This report contains three volumes. Volume 1 contains the Specifications for all chapters and sections of the improved STS. Volume 2 contains the Bases for Chapters 2.0 and 3.0, and Sections 3.1–3.3 of the improved STS. Volume 3, contains the Bases for Sections 3.4–3.10 of the improved STS.

2989 (STUK-B-YTO–97) **Operation of Finnish nuclear power plants.** Tossavainen, K. (ed.). Finnish Centre for Radiation and Nuclear Safety (STUK), Helsinki (Finland). May 1992. 24p. Order Number DE93607702. Source: OSTI; NTIS; INIS.

Published also in Finnish as report number STUK-B-YTO–93.

The Finnish nuclear power plant units Loviisa 1 and 2 as well as TVO I and II were in operation for almost the whole fourth quarter of 1991. The load factor average was 94.7 % (the whole year 90.9 %). All the events in the last annual quarter, which are classified on the International Nuclear Event Scale, were below scale/level 0. Also the events which occurred in the other quarters of the year 1991 were rated at the scale's lowest levels. Occupational radiation doses and releases of radioactive material off-site remained well below authorised limits. Only quantities of radioactive material insignificant to radiation exposure originating in nuclear power plants

were detected in the samples collected in the vicinity of the nuclear power plants.

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Refer also to citation(s) 2692, 2989, 3064, 3078, 3098, 3314, 3315, 3316, 3317, 3318, 3319, 3320, 3321, 3322, 3323, 3324, 3325, 3326, 3327, 3328, 3329, 3330, 3332, 3333, 3334, 3335, 3336, 3337, 3340, 3341, 3342, 3343, 3344, 3345, 3346, 3347, 3348, 3349, 3350, 3351, 3352, 3353, 3354, 3356, 3357, 3358, 3359, 3360, 3361, 3362, 3363, 3364, 3366, 3367, 3368, 3369, 3370, 3371, 3372, 3376, 3377, 3378, 3379, 3380, 3381, 3382, 3383, 3384, 3385, 3386, 3387, 3388, 3389, 3390, 3391, 3392, 3393, 3394, 3395, 3396, 3400, 3402, 3403, 3407, 3408, 3409, 3411, 3412, 3413, 3414, 3416, 3417, 3418, 3419, 3421, 3422, 3423, 3425, 3426, 3427, 3428, 3429, 3430, 3431, 3432, 3435, 3436, 3438, 3439, 3441

2990 (CDTN-DETR-NT–248/89) **Rod drop accident analysis for Angra 1.** Veloso, M.A.; Atayde, P.A.; Sakai, M. Centro de Desenvolvimento da Tecnologia Nuclear (CDTN), Belo Horizonte, MG (Brazil). 12 Apr 1989. 17p. Order Number DE93607748. Source: OSTI; NTIS (US Sales Only); INIS.

A methodology for analysing the rod drop accident in pressurized water reactors operating in the automatic control mode. Calculations concerning the third cycle of the Angra 1 Nuclear Power Plant are used to illustrate the application of this methodology is presented. In this analysis all possible configurations for dropped rods caused by a single failure in the controller circuits have been considered. The dropped rod worths, power distributions and ex core detector tilts are determined by using the Siemens/KWU nuclear code system, in particular the MEDIUM, PINPOW and DETILT codes. The transient behaviour of the plant during the rod drop event is simulated with the SACI2 code, developed at CDTN. Determinations related to the DNBR design limit are conducted by utilizing the KWU PUMA2 code. It must be emphasized that the present work is only intended to propose a method to analyse the rod drop accident. For the purpose of licensing, the analysis must be repeated, with the participation of FURNAS, taking into account the actual control and protection conditions of Angra 1. (Author).

2991 (CNEN-DR–136/87) **Program for analysis and evaluation of operational data in nuclear power plants - statistical of operational incident of 1984 to 1985 from Angra-1.** Soares, H.V.; Ambros, P.C.; Araujo, J.B. Comissao Nacional de Energia Nuclear (CNEN), Rio de Janeiro, RJ (Brazil). Dept. de Reatores. Jan 1987. 52p. (In Portuguese). Order Number DE93607751. Source: OSTI; NTIS (US Sales Only); INIS.

The reports of CNEN in the years of 1984 - 1985 regarding reactor accidents. These reports are divided into five classes: reactor shutdown, operator of the core emergency cooling system, power plant operating at limit conditions, radioactivity contamination and super exposition is presented. (A.C.A.S.).

2992 (CNEN-DR-GAN-NT–03/87) **Considerations on the implementation of FRAPCON-1 computer code.** Silva, C.F. da; Chia, C.T. Comissao Nacional de Energia Nuclear (CNEN), Rio de Janeiro, RJ (Brazil). Dept. de Reatores. May 1987. 88p. (In Portuguese). Order Number DE93607749. Source: OSTI; NTIS (US Sales Only); INIS.

The various steps in the implementation of FRAPCON-1 computer code using CDC, IBM and HB computers is described. (A.C.A.S.).

2993 (CNEN-DR-GAN-NT–07/87) **Stage of GAN (Grupo de Analise do Nucleo) calculus methodology.** Silva, C.F. da. Comissao Nacional de Energia Nuclear (CNEN), Rio de Janeiro, RJ (Brazil). Dept. de Reatores. Nov 1987. 52p. (In Portuguese). Order Number DE93607750. Source: OSTI; NTIS (US Sales Only); INIS.

This Technical Note presents the stage of GAN Calculus Methodology in areas of Neutronics, Fuel Rod Performance and Fission Products Inventory. Proposals of GAN's members are presented and analyzed for each of these areas and a work schedule is established. (author).

2994 (CTA-IEAV-RP–010/85) **Spatial oscillation control in power reactors and numerical calculations.** Amorim, E.S.; Moura Neto, C. Centro Tecnico Aeroespacial (CTA-IEAv), Sao Jose dos Campos, SP (Brazil). Inst. de Estudos Avancados. 12 Apr 1985. 76p. (In Portuguese). Order Number DE93607752. Source: OSTI; NTIS (US Sales Only); INIS.

This work uses the neutron two-groups model to establish the basic equations of spatial Xe oscillations control in power reactors. It is considered that slow neutrons and temperature alignment are in equilibrium with the neutron flux. (A.C.A.S.).

2995 (IAEA-TECDOC–660, pp. 111-130) **Expert systems monitoring in a nuclear power plant: A living example and prospects at EDF.** Cheriaux, F. (Electricite de France, Chatou (France). Research and Development Div.); Ancelin, J. International Atomic Energy Agency, Vienna (Austria). Jul 1992. (CONF-9109435–: Technical committee meeting/workshop on demonstration and review of expert system prototypes, Springfields (United Kingdom), 30 Sep 1991). In *Expert systems in the nuclear industry: Report of a technical committee meeting/workshop held in Springfields, United Kingdom, 30 September - 4 October 1991.* 219p. Order Number DE93606682. Source: OSTI; NTIS (US Sales Only); INIS.

For many years, E.D.F. has had a plan for the development of computerized operator support systems to help monitoring and supervising its plants. After a short introduction about the general context of computerized operator support systems in nuclear plants (connections of these systems, potential users, expected functionalities, kind of knowledge to be used), some examples illustrates the significance of the artificial intelligence techniques and methods for building these systems, and more particularly the model-based automatic programming approach. Then the technological features of the KSE system (expert system monitoring electric power supplies in a PWR plant) are quoted. This system represents a living example of a computerized operator support system installed in a control room which uses explicit modelling of the plant and model-based reasoning techniques. This application largely relies on advanced computer techniques: artificial intelligence, data bases, real-time systems and computer graphics. The KSE system was commissioned in unit 2 of the Bugey power plant in November 1989 and is in use since. A set of targets to reach, is then defined to extend to a wider field the functionalities of this type of operator support system, involving in particular some thermal-hydraulic aspects. Therefore, we have to take into account the time aspects and the continuous change of physical parameters. 29 refs, 9 figs.

2996 (IAEA-TECDOC–660, pp. 173-179) **Cerbere/Hades; Fuel reload automatic calculation system.** Chaix, V. (Fragema-Framatome Div. Combustible, Lyon (France)). International Atomic Energy Agency, Vienna (Austria). Jul 1992. (CONF-9109435–: Technical committee meeting/workshop on demonstration and review of expert system prototypes, Springfields (United Kingdom), 30 Sep 1991). In *Expert systems in the nuclear industry: Report of a technical committee meeting/workshop held in Springfields, United Kingdom, 30 September - 4 October 1991.* 219p. Order Number DE93606682. Source: OSTI; NTIS (US Sales Only); INIS.

When a pressurized water reactor is shut down at the end of a cycle (once per year in France) refuelling takes place. This operation involves unloading of some assemblies, usually the most-spent, and their replacement by the same number of fresh fuel assemblies. Thus, the core is arranged in a new loading pattern with optimum distribution of the differently burnt assemblies, so that the most uniform possible power distribution is achieved. To guarantee plant safety for the next cycle by verifying a number of neutronic criteria related to the safety of the plant and to ensure the latter operates according to the technical specifications, FRAGEMA supplies a safety document to its customer EDF. This document summarizes the results of the studies arising from this new loading scheme. (author).

2997 (IAEA-TECDOC–660, pp. 181-195) **Expert system for operator support.** Zbytovsky, V. (Ustav Jaderneho Vyzkumu CSKAE, Rez (Czechoslovakia)); Vasa, I.; Fiser, V.; Sikora, J.; Tschiesche, J.; Mickal, V.; Kubin, R. International Atomic Energy Agency, Vienna (Austria). Jul 1992. (CONF-9109435–: Technical

committee meeting/workshop on demonstration and review of expert system prototypes, Springfields (United Kingdom), 30 Sep 1991). In *Expert systems in the nuclear industry: Report of a technical committee meeting/workshop held in Springfields, United Kingdom, 30 September - 4 October 1991.* 219p. Order Number DE93606682. Source: OSTI; NTIS (US Sales Only); INIS.

The paper describes the general approach, present state and future prospects of the Expert System for Operator Support (ESOS) developed in the Nuclear Research Institute at Rez near Prague (NRI). This system should be used in the WWER-440 type Nuclear power plant Dukovany. The characteristic features of ESOS are as follows: Main functions of ESOS (process monitoring, diagnostic, advising) are realized by modern ideas of several mutually cooperating expert systems; ESOS is a real-time system connected on-line to the NPP's process; ESOS is pronounced modular system, that enables us to connect additional modules with other functions, or remove of modify some of the original ones; Graphic communication, which simplifies the communication with the user (NPP's operator). The principal features of the all expert systems (RECON, DIAG, ADVISE) and their communication are described in more detail. The experience with creating and testing knowledge bases for diagnostics of steam-generator valves and escapes of cool water (less than 60 t/h) is also described. 3 refs, 4 figs.

2998 (INIS-BR–2946) **The plutonium recycle for PWR reactors from brazilian nuclear program.** Rubini, L.A. Instituto Militar de Engenharia (IME), Rio de Janeiro, RJ (Brazil). 1978 195p. (In Portuguese). Order Number DE93607753. Source: OSTI; NTIS (US Sales Only); INIS.

The purpose of this thesis is to evaluate the material requirements of the nuclear fuel cycle with plutonium recycle. The study starts with the calculation of a reference reactor and has flexibility to evaluate the demand under two alternatives of nuclear fuel cycle for Pressurized Water Reactors (PWR): Without plutonium recycle; and with plutonium recycle. Calculations of the reference reactor have been carried out with the CELL-CORE codes. Variations in the material requirements were studied considering changes in the installed nuclear capacity of PWR reactors, the capacity factor of these reactors, and the introduction of fast breeders. Recycling plutonium produced inside the system can reach economies of about 5% $U_3 O_8$ and 6% separative work units if recycle is assumed only after the fifth operation cycle of the thermal reactors. (author).

2999 (INIS-BR–2956) **Transient study of a PWR pressurizer.** Sotoma, H. Universidade Federal, Rio de Janeiro, RJ (Brazil). Coordenacao dos Programas de Pos-graduacao de Engenharia. 1973 144p. (In Portuguese). Order Number DE93607754. Source: OSTI; NTIS (US Sales Only); INIS.

An appropriate method for the calculation and transient performance of the pressurizer of a pressurized water reactor is presented. The study shows a digital program of simulation of pressurizer dynamics based on the First Law of Thermodynamic and Laws of Heat and Mass Transfer. The importance of the digital program that was written for a pressurizer of PWR, lies in the fact that, this can be of practical use in the safety analysis of a reactor of Angra dos Reis type with a power of about 500 M We. (author).

3000 (INIS-BR–2971) **Modal analysis of temperature feedback in oscillations induced by xenon.** Passos, E.M. dos. Instituto Militar de Engenharia (IME), Rio de Janeiro, RJ (Brazil). 1976 96p. (In Portuguese). Order Number DE93607755. Source: OSTI; NTIS (US Sales Only); INIS.

The flux oscillations induced by Xenon distribution in homogeneous thermal reactors are studied treating the space dependence through the modal expansion technique and the stability limits against power oscillations and spatial oscillations are determined. The effect of the feedbacks due to Xenon and temperature coefficient on the linear stability of the free system is investigated employing several number of terms in the transient expansion, considering the various sizes of the reactor. The heat transfer model considered includes one term due to cooling proportional to the temperature. A PWR model reactor is utilized for numerical calculations. It is found that a slightly higher temperature feedback coefficient is necessary for stability against power oscillations when larger number of terms in the transient modal expansion is maintained. (author).

3001 (INIS-BR–2973) **Modal analysis of spatial effects on transients in nuclear power reactor.** Agueda, O. Instituto Militar de Engenharia (IME), Rio de Janeiro, RJ (Brazil). 1976 78p. (In Portuguese). Order Number DE93607756. Source: OSTI; NTIS (US Sales Only); INIS.

The solution of the linearized space dependant reactor kinetics equations with fuel and moderator temperature coefficient feed backs are obtained by modal analysis. The heat transfer from fuel to moderator is explicitly considered through the heat balance equations. The delayed neutrons are lumped into one group. The space dependant transients due to localized perturbation such as insertion of fuel rod or withdrawal of control rod and uniform perturbation such as fractional loss of the coolant flow in a PWR are determined and compared with the solutions of space independent solutions. Transients resulting from a simultaneous introduction of localized and uniform perturbation are also examined. (author).

3002 (INIS-BR–2974) **Nonlinear punctual dynamic applied to simulation of PWR type reactors.** Cysne, F.S. Instituto Militar de Engenharia (IME), Rio de Janeiro, RJ (Brazil). 1978 90p. (In Portuguese). Order Number DE93607757. Source: OSTI; NTIS (US Sales Only); INIS.

In order to study some kinds of nuclear reactor accidents, a simulation is made using the punctual kinetics model to the reactor core. The following integration methods are used: Hansen's method in which a linearization is made and C S M P using a variable interval fourth-order Runge Kutta method. The results were good and were compared with those obtained by the code Dinamica I which uses a finite difference integration method of backward kind. (author).

3003 (INIS-BR–2978) **Optimization of control poison management by dynamic programming.** Ponzoni Filho, P. Instituto Militar de Engenharia (IME), Rio de Janeiro, RJ (Brazil). 1974 86p. (In Portuguese). Order Number DE93607758. Source: OSTI; NTIS (US Sales Only); INIS.

A dynamic programming approach was used to optimize the poison distribution in the core of a nuclear power plant between reloading. This method was applied to a 500 M We PWR subject to two different fuel management policies. The beginning of a stage is marked by a fuel management decision. The state vector of the system is defined by the burnups in the three fuel zones of the core. The change of the state vector is computed in several time steps. A criticality conserving poison management pattern is chosen at the beginning of each step. The burnups at the end of a step are obtained by means of depletion calculations, assuming constant neutron distribution during the step. The violation of burnup and power peaking constraints during the step eliminates the corresponding end states. In the case of identical end states, all except that which produced the largest amount of energy, are eliminated. Among the several end states one is selected for the subsequent stage, when it is subjected to a fuel management decision. This selection is based on an optimally criterion previously chosen, such as: discharged fuel burnup maximization, energy generation cost minimization, etc. (author).

3004 (INIS-BR–2980) **Computer code for simulating pressurized water reactor core.** Serrano, A.M.B. Instituto Militar de Engenharia (IME), Rio de Janeiro, RJ (Brazil). 1978 200p. (In Portuguese). Order Number DE93607759. Source: OSTI; NTIS (US Sales Only); INIS.

A computer code was developed for the simulation of the steady-state and transient behaviour of the average channel of a Pressurizer Water Reactor core. Point kinetics equations were used with the reactivity calculated for average temperatures in the channel with the fuel and moderator temperature feedbacks. The radial heat conduction equation in the fuel was solved numerically. For calculating the thermodynamic properties of the coolant, the fundamental equations of conservation (mass, energy and momentum) were solved. The gap and clad were treated as a resistance added to the film coefficient. The fuel system equations were decoupled from the coolant equations. The program permitted the changes in the heat transfer correlations and the flow patterns along the coolant channel. Various test were performed to determine the steady-state and transient response employing the PWR

core simulator developed, obtaining results with adequate precision. (author).

3005 (INIS-BR–3023) **Occupational exposure analysis at the unit 1 of Almirante Alvaro Alberto nuclear power plant.** Moraes, A. Universidade do Estado, Rio de Janeiro, RJ (Brazil). Centro Biomedico. 1985 291p. (In Portuguese). Order Number DE93607760. Source: OSTI; NTIS (US Sales Only); INIS.

In order to obtain a complete knowledge of occupational conditions in a PWR nuclear power station, the individual and collective dose distributions are being analysed during the Angra I (Rio de Janeiro - Brazil) station activities. Work conditions with identification of critical areas and groups as well as classification of tasks related to reactor maintenance and startup periods are also studied. This paper analyses radiological data measured at different power levels of the reactor and during maintenance and repair services as well as the refueling operation. (author).

3006 (INIS-BR–3054) **SEMPaC - an expert system prototype associated with safety parameter display system of a nuclear power plant.** Hirama, K. Sao Paulo Univ., SP (Brazil). Escola Politecnica. 1989 247p. (In Portuguese). Order Number DE93607761. Source: OSTI; NTIS (US Sales Only); INIS.

This work presents SEMPaC, an expert system prototype: it provides means to support diagnosis and to make decisions during abnormal transients that cause the trip of nuclear power plant. The system operation is associated with Safety Parameter Display System - SPDS that was recommended by U. S. Nuclear Regulatory Commission (NRC) after the Three-Mile Island (TMI) accident analysis. (author).

3007 (INIS-mf–13380) **Report concerning Zarnowiec nuclear power plant.** Albinowski, S. (Warsaw Univ. (Poland)); Dakowski, M.; Downarowicz, M. Zespol Prezesa Panstwowej Agencji Atomistyki do Spraw Elektrowni Jadrowej Zarnowiec, Warsaw (Poland). 6 Jun 1990 65p. (In Polish). Order Number DE93607762. Source: OSTI; NTIS (US Sales Only); INIS.

Report of the Team of the President of the National Atomic Energy Agency regarding Zarnowiec nuclear power plant contains the analysis of situation in Poland in June 1990, the assessment of public opinion, as well as the description of ecological, technical and economical problems. The team's conclusions are given together with the general conclusion to stop the construction of Zarnowiec nuclear power plant. 5 appendixes, 6 enclosures, 1 documents list, 1 tab. (A.S.).

3008 (KAERI/TR–222/91) **Nuclear design report for Kori nuclear power plant Unit 3 Cycle 7.** Kim, Jae Hak (Korea Atomic Energy Research Inst., Daeduk (Korea, Republic of)); Park, Sang Yoon; Song, Jae Woong; Park, Chan Oh. Korea Atomic Energy Research Inst., Daeduk (Korea, Republic of). Nov 1991. 101p. Order Number DE93607763. Source: OSTI; NTIS (US Sales Only); INIS.

This report presents nuclear design calculations for Cycle 7 of Kori Unit 3. Information is given on fuel loading, power density distributions, reactivity coefficients, control rod worths and operational limits. In addition the report contains all necessary data for the startup tests including predicted values for the comparison with the measured data. The reload consists of 48 KOFA's enriched by nominally 3.50 w/o U235. Among the KOFA's, 24 fuel assemblies contain gadolinia rods. The fuel assemblies in the core are arranged in a low leakage loading pattern. The cycle length of Cycle 7 amounts to 293 EFPD corresponding to a cycle burnup of 11900 MWD/MTU. (Author).

3009 (KAERI/TR–244/92) **Nuclear design report of Yonggwang nuclear power plant Unit 2 Cycle 6.** Lee, Ki Bok (Korea Atomic Energy Research Inst., Daeduk (Korea, Republic of)); Park, Sang Yoon; Song, Jae Woong; Park, Chan Oh. Korea Atomic Energy Research Inst., Daeduk (Korea, Republic of). Feb 1992. 117p. Order Number DE93607764. Source: OSTI; NTIS (US Sales Only); INIS.

This report presents nuclear design calculations for Cycle 6 of Yonggwang Unit 2. Information is given on fuel loading, power density distributions, reactivity coefficients, control rod worths and operational limits. In addition, the report contains all necessary data for the startup tests including predicted values for the comparison with the measured data. The reload consists of 48 KOFA's enriched by nominally 3.50 w/o U235. Among the KOFA's, 20 fuel assemblies contain gadolinia rods. The fuel assemblies in the core are arranged in a low leakage loading pattern. The cycle length of Cycle 6 amounts to 298 EFPD corresponding to a cycle burnup of 12000 MWD/MTU. (Author).

3010 (NUCLEBRAS-IPR–385) **Contribution to fuel depletion study in PWR type reactors, reactor core with three and four regions of enrichment.** Teixeira, M.C.C. NUCLEBRAS, Rio de Janeiro, RJ (Brazil). Diretoria de Tecnologia e Desenvolvimento. Mar 1977. 173p. (In Portuguese). Order Number DE93607765. Source: OSTI; NTIS (US Sales Only); INIS.

The main methods for calculation of fuel depletion are studied and some approaches to do it are mentioned; the LEOPARD Code is described and full details are given for each subroutine, flow charts are included; the method given by the code for calculation of fuel depletion is described; some imperfections from the IPR's version are listed, and corrected, for instance: the method for burnup calculation of heavy isotopes; the results of calculations for a reference reactor based on data of the Preliminary Safety Analysis Report (PSAR) for Angra I Nuclear Power Plant are presented and discussed. (author).

3011 (NUREG–1275-Vol.7) **Operating experience feedback report: Experience with pump seals installed in reactor coolant pumps manufactured by Byron Jackson: Commercial power reactors, Volume 7.** Bell, L.G.; O'Reilly, P.D. Nuclear Regulatory Commission, Washington, DC (United States). Div. of Safety Programs. Sep 1992. 71p. Sponsored by Nuclear Regulatory Commission, Washington, DC (United States). Source: OSTI; NTIS; INIS; GPO.

This report examines the reactor coolant pump (RCP) seal operating experience through August 1990 at plants with Byron Jackson (B-J) RCPs. ne operating experience examined in this analysis included a review of the practice of continuing operation with a degraded seal. Plants with B-J RCPs that have had relatively good experience with their RCP seals attribute this success to a combination of different factors, including: enhanced seal QA efforts, modified/new seal designs, improved maintenance procedures and training, attention to detail, improved seal operating procedures, knowledgeable personnel involved in seal maintenance and operation, reduction in frequency of transients that stress the seals, seal handling and installation equipment designed to the appropriate precision, and maintenance of a clean seal cooling water system. As more plants have implemented corrective measures such as these, the number of B-J RCP seal failures experienced has tended to decrease. This study included a review of the practice of continued operation with a degraded seal in the case of PWR plants with Byron Jackson reactor coolant pumps. Specific factors were identified which should be addressed in order to safety manage operation of a reactor coolant pump with indications of a degrading seal.

3012 (NUREG–1430-Vol.1) **Standard Technical Specifications, Babcock and Wilcox plants: Volume 1, Specifications.** Nuclear Regulatory Commission, Washington, DC (United States). Div. of Operational Events Assessment. Sep 1992. 340p. Sponsored by Nuclear Regulatory Commission, Washington, DC (United States). Source: OSTI; NTIS; INIS; GPO.

This NUREG contains improved Standard Technical Specifications (STS) for Babcock and Wilcox (B&W) Plants and documents the positions of the Nuclear Regulatory Commission based on the B&W Owners Group's proposed STS. This document is the result of extensive technical meetings and discussions among the NRC staff, the Nuclear Steam Supply System (NSSS) Owners Groups, the NSSS vendors, and the Nuclear Management and Resources Council (NUMARC). The unproved STS were developed based on the, criteria in the interim Commission Policy Statement on Technical Specification Improvements for Nuclear Power Reactors, dated February 6, 1987. The improved STS will be used as the basis for individual nuclear power plant licensees to develop proved plant-specific technical specifications. This report contains three volumes. This document, Volume 1 contains the Specifications for all chapters and sections of the improved STS.

3013 (NUREG–1431-Vol.1) **Standard Technical Specifications, Westinghouse plants: Volume 1, Specifications.** Nuclear Regulatory Commission, Washington, DC (United States). Div. of Operational Events Assessment. Sep 1992. 423p. Sponsored by Nuclear Regulatory Commission, Washington, DC (United States). Source: OSTI; NTIS; INIS; GPO.

This NUREG contains improved Standard Technical Specifications (STS) for Westinghouse Plants and documents the positions of the Nuclear Regulatory Commission based on the Westinghouse Owners Group's proposed STS. This document is the result of extensive technical meetings and discussions among the NRC staff, the Nuclear Steam Supply System (NSSS) Owners Groups, the NSSS vendors, and the Nuclear Management and Resources Council (NUMARC). The improved STS were developed based on the criteria in the interim Commission Policy Statement on Technical Specification Improvements for Nuclear Power Reactors, dated February 6, 1987. The improved STS will be used as the basis for individual nuclear power plant licensees to develop improved plant-specific technical specifications. This report contains three volumes. This document, Volume 1, contains the Specifications for all chapters and sections of the improved STS. Volume 2 contains the Bases for Chapters 2.0 and 3.0, and Sections 3.1–3.3 of the improved STS. Volume 3 contains the Bases for Sections 3.4–3.9 of the improved STS.

3014 (NUREG–1432-Vol.2) **Standard Technical Specifications, Combustion Engineering plants: Volume 2, Bases (Sections 2.0-3.3).** Nuclear Regulatory Commission, Washington, DC (United States). Div. of Operational Assessment. Sep 1992. 596p. Sponsored by Nuclear Regulatory Commission, Washington, DC (United States). Source: OSTI; NTIS; INIS; GPO.

This NUREG contains improved Standard Technical Specifications (M) for Combustion Engineering (CE) Plants and documents the positions of the Nuclear Regulatory Commission based on the CE Owners Group's proposed STS. This document is the result of extensive technical meetings and discussions among the NRC staff, the Nuclear Steam Supply System (NSSS) Owners Groups, the NSSS vendors, and the Nuclear Management and Resources Council (NUMARC). The improved STS were developed based on the criteria in the interim Commission Policy Statement on Technical Specification Improvements for Nuclear Power Reactors, dated February 6, 1987. The improved STS will be used as the basis for individual nuclear power plant licensees to develop improved plant-specific technical specifications. This report contains three volumes. Volume 1 contains the Specifications for all chapters and sections of the improved STS. This document Volume 2 contains the Bases for Chapters 2.0 and 3.0, and Sections 3.1–3.3 of the improved STS. Volume 3 contains the Bases for Sections 3.4–3.9 of the improved STS.

3015 (NUREG–1432-Vol.3) **Standard Technical Specifications, Combustion Engineering plants: Volume 3, Bases (Sections 3.4–3.9).** Nuclear Regulatory Commission, Washington, DC (United States). Div. of Operational Events Assessment. Sep 1992. 435p. Sponsored by Nuclear Regulatory Commission, Washington, DC (United States). Source: OSTI; NTIS; INIS; GPO.

This NUREG contains improved Standard Technical Specifications (STS) for Combustion Engineering (CE) Plants and documents the positions of the Nuclear Regulatory Commission based on the CE Owners Group's proposed STS. This document is the result of extensive technical meetings and discussions among the NRC staff, the Nuclear Steam Supply System (NSSS) Owners Groups, the NSSS vendors, and the Nuclear Management and Resources Council (NUMARC). The improved STS were developed based on the criteria in the interim Commission Policy Statement on Technical Specification Improvements for Nuclear Power Reactors, dated February 6, 1987. The improved STS will be used as the basis for individual nuclear power plant licensees to develop improved plant-specific technical specifications. This report contains three volumes. Volume 1 contains the Specifications for all chapters and sections of the improved SM. Volume 2 contains the Bases for Chapters 2.0 and 3.0, and Sections 3.1–3.3 of the improved STS. This document Volume 3 contains the Bases for Sections 3.4–3.9 of the improved M.

3016 (NUREG/CR–5828) **Emergency feedwater system risk-based inspection guide for the Arkansas Nuclear One Unit 2 Power Plant.** Pugh, R.; Gore, B.F.; Vo, T.V. Nuclear Regulatory Commission, Washington, DC (United States). Div. of Radiation Protection and Emergency Preparedness; Pacific Northwest Lab., Richland, WA (United States). Sep 1992. 27p. Sponsored by Nuclear Regulatory Commission, Washington, DC (United States). DOE Contract AC06-76RL01830. (PNL–7727). Source: OSTI; NTIS; INIS; GPO.

In a study sponsored by the US Nuclear Regulatory Commission (NRC), Pacific Northwest Laboratory has developed and applied a methodology for deriving plant-specific risk-based inspection guidance for the auxiliary feedwater (AFW) system at pressurized water reactors that have not undergone probabilistic risk assessment (PRA). This methodology uses-existing PRA results and plant operating experience information. Existing PRA-based inspection guidance information recently developed for the NRC for various plants was used to identify generic component failure modes. This information was then combined with plant-specific and industry-wide component information and failure data to identify failure modes and failure mechanisms for the AFW system at the selected plants. Arkansas Nuclear One Unit 2 was selected as one of a series of plants for study. The product of this effort is a prioritized listing of AFW failures which have occurred at the plant and at other PWRS. This listing is intended for use by NRC inspectors in the preparation of inspection plans addressing AFW risk-important components at the Arkansas Nuclear One Unit 2 plant.

3017 (NUREG/CR–5838) **Auxiliary feedwater system risk-based inspection guide for the Virgil C. Summer Nuclear Power Plant.** Lloyd, R.C. (Pacific Northwest Lab., Richland, WA (United States)); Moffitt, N.E.; Gore, B.F.; Vo, T.V.; Bumgardner, J.D. Nuclear Regulatory Commission, Washington, DC (United States). Div. of Radiation Protection and Emergency Preparedness; Pacific Northwest Lab., Richland, WA (United States). Sep 1992. 31p. Sponsored by Nuclear Regulatory Commission, Washington, DC (United States). DOE Contract AC06-76RL01830. (PNL–7924). Source: OSTI; NTIS; INIS; GPO.

In a study sponsored by the US Nuclear Regulatory Commission (NRC), Pacific Northwest Laboratory has developed and applied a methodology for deriving plant-specific risk-based inspection guidance for the emergency/auxiliary feedwater (EFW/AFW) system at press water reactors that have not undergone probabilistic risk assessment (PRA). This methodology uses costing PRA results and plant operating experience information. Existing PRA-based inspection guidance information recently developed for the NRC for various plants was used to identify genetic component failure modes. This information was then combined with plant-specific and industry-wide component information and failure data to identify failure modes and failure mechanisms for the AFW system at the selected plants. Virgil C. Summer plant was selected as one m a series of plants for study. The product of this effort is a priority listing of AFW failures which have occurred at the plant and at other PWRS. This listing is intended for use by NRC inspectors in the preparation of inspection plans addressing AFW risk-important components at Virgil C. Summer plant.

2103 Power Reactors, Nonbreeding, Graphite Moderated

Refer also to citation(s) 3025, 3077, 3299, 3319, 3375, 4637

3018 (GA-A–21079) **Potential applications of high temperature helium.** Schleicher, R.W. Jr.; Kennedy, A.J. General Atomics, San Diego, CA (United States). Sep 1992. 16p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC03-89SF17885. (CONF-9210184–1: 2. Japan Atomic Energy Research Institute (JAERI) symposium on high temperature gas-cooled reactor (HTGR) technologies, Ibaraki-ken (Japan), 21-23 Oct 1992). Order Number DE93001419. Source: OSTI; NTIS; INIS; GPO Dep.

This paper discusses the DOE MHTGR-SC program's recent activity to improve the economics of the MHTGR without sacrificing

safety performance and two potential applications of high temperature helium, the MHTGR gas turbine plant and a process heat application for methanol production from coal.

2104 Power Reactors, Nonbreeding, Otherwise Moderated Or Unmoderated

Refer also to citation(s) 3181, 3186, 3198, 3216, 3272, 3373, 3389

3019 (IAEA-TECDOC–660, pp. 143-145) **Development of expert systems based on PSA models for the Cernavoda nuclear power plant.** Georgescu, G. (Institute for Nuclear Research, Pitesti (Romania)). International Atomic Energy Agency, Vienna (Austria). Jul 1992. (CONF-9109435–: Technical committee meeting/workshop on demonstration and review of expert system prototypes, Springfields (United Kingdom), 30 Sep 1991). In *Expert systems in the nuclear industry: Report of a technical committee meeting/workshop held in Springfields, United Kingdom, 30 September - 4 October 1991.* 219p. Order Number DE93606682. Source: OSTI; NTIS (US Sales Only); INIS.

The paper presents the status and further development of the PSA models based software and expert systems, for design, regulation and operation of the 5 units N.P.P., CANDU type under construction in Cernavoda. One of the most important aims of the PSA activity for NPP Cernavoda is to develop a "living PSA" tool which will be used for on-line risk-based plant management and also for design and regulations. This computerized system will be developed taking into account the necessities of the activities connected and the world experience in this field. (author). 5 refs.

2105 Power Reactors, Breeding

Refer also to citation(s) 3047, 3070, 3076, 3122, 3319, 3374, 3413

3020 (ANL/CP–72053) **The characterization and monitoring of metallic fuel breaches in EBR-2.** Pahl, R.G.; Batte, G.L.; Mikaili, R.; Lambert, J.D.B.; Hofman, G.L. Argonne National Lab., IL (United States). [1991]. 10p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-31109-ENG-38. (CONF-911001–27: International conference on fast reactor systems and fuel cycles, Kyoto (Japan), 27 Oct - 1 nov 1991). Order Number DE92041094. Source: OSTI; NTIS; INIS; GPO Dep.

This paper discusses the characterization and monitoring of metallic fuel breaches which is now a significant part of the Integral Fast Reactor fuel testing program at Argonne National Laboratory. Irradiation experience with failed metallic fuel now includes natural breaches in the plenum and fuel column regions in lead "endurance" tests as well as fuel column breaches in artificially-defected fuel which have operated for months in the run-beyond-cladding breach (RBCB) mode. Analyses of the fission gas (FG) release-to-birth (R/B) ratios of selected historical breaches have been completed and have proven to be very useful in differentiating between plenum and fuel column breaches.

3021 (CTA-IEAV-RI–04/86) **On the development of fast breeder reactors and the use of thorium in Brazil.** Ishiguro, Y. Centro Tecnico Aeroespacial (CTA-IEAv), Sao Jose dos Campos, SP (Brazil). Inst. de Estudos Avancados. Oct 1986. 41p. (In Portuguese). Order Number DE93607797. Source: OSTI; NTIS (US Sales Only); INIS.

This work presents a discussion on the possibility of construction of fast breeder reactors in Brazil. It is specially concerned with the use of thorium which is abundant in our country. The main advantages of this projects are: develop fuel and reactor technology in Brazil, increase thorium research, demonstrate the safety of LMFBR and promote its public acceptance. (A.C.A.S.).

3022 (INIS-BR–2942, pp. 134-135) **Development of computer program for sodium fires calculations.** Goncalves, A.C. (Instituto de Engenharia Nuclear (IEN), Rio de Janeiro, RJ (Brazil). Div. de Metais Liquidos); Torres, A.R.; Correa, S.M.; Castro, P.M. Instituto de Engenharia Nuclear (IEN), Rio de Janeiro, RJ (Brazil). Dept. de Reatores. 1989. 147p. (In Portuguese). (CONF-880440–: 2. Brazilian meeting on nuclear energy, Rio de Janeiro (Brazil), 23-26 Apr 1988). In *Triennial technical report - 1986, 1987, 1988 - Instituto de Engenharia Nuclear (IEN) -Dept. of Reactors (DERE).* Order Number DE93605069. Source: OSTI; NTIS (US Sales Only); INIS.

Published in summary form only. SODIUM/fires; ACCIDENTS; COMBUSTION; COMPUTER CALCULATIONS; COOLANT LOOPS; F CODES; FAST REACTORS; LIQUID METALS; REACTION KINETICS; SMOKES; SODIUM; FIRES

3023 (INIS-BR–2948) **A methodology of neutronic-thermodynamics simulation for fast reactor.** Waintraub, M. Universidade Federal, Rio de Janeiro, RJ (Brazil). Coordenacao dos Programas de Pos-graduacao de Engenharia. 1986 188p. (In Portuguese). Order Number DE93607798. Source: OSTI; NTIS (US Sales Only); INIS.

Aiming at a general optimization of the project, controlled fuel depletion and management, this paper develop a neutronic thermodynamics simulator, SIRZ, which besides being sufficiently precise, is also economic. That results in a 75% reduction in CPU time, for a startup calculation, when compared with the same calculation at the CITATION code. The simulation system by perturbation calculations, applied to fast reactors, which produce errors smaller than 1% in all components of the reference state given by the CITATION code was tested. (author).

3024 (KFK–4989) **Inherently effective shutdown system with Curie point controlled sensor/switch unit.** Bojarsky, E.; Mueller, K.; Reiser, H. Kernforschungszentrum Karlsruhe GmbH (Germany). Inst. fuer Materialforschung; Kernforschungszentrum Karlsruhe GmbH (Germany). Projekt Nukleare Sicherheitsforschung. May 1992. 36p. Order Number DE93729132. Source: OSTI; NTIS (US Sales Only); INIS.

Within the framework of activities devoted to the safety of fast breeder reactors a concept has been elaborated for an inherently effective shutdown system. The key element of this system is a Curie point controlled sensor/switch unit. In case of an inadmissible rise in the sodium temperature at the fuel element outlet the unit interrupts without support from outside the current supply to the electromagnetic absorber rod holding coupling and thus releases automatically the drop of the absorber into the reactor. It is possible to arrange the switch units, independent of the shutdown elements, directly above the heads of selected fuel elements, thus achieving very short response times. Both out-of-pile and in-pile long-term experiments have been performed on a multitude of switch units at elevated temperatures. The results show that shutdown takes place within a very narrow range of temperatures. The test switches remained fully operative until the end of the experiment. (orig.).

2106 Power Reactors, Mobile, Propulsion, Package, and Transportable

Refer also to citation(s) 4638

3025 (CONF-930103–3) **Space power reactor ground test in the Experimental Gas Cooled Reactor (EGCR) at Oak Ridge.** Fontana, M.H.; Holcomb, R.S.; Cooper, R.H. Oak Ridge National Lab., TN (United States). [1992]. 7p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. From 10. symposium on space nuclear power and propulsion; Albuquerque, NM (United States); 10-14 Jan 1993. Order Number DE92016788. Source: OSTI; NTIS; GPO Dep.

The Experimental Gas Cooled Reactor (EGCR) facility and the supporting technical infrastructure at the Oak Ridge National Laboratory have the capabilities of performing ground tests of space nuclear power reactor systems. A candidate test would be a 10 MWt lithium cooled reactor, generating potassium vapor that would drive a power turbine. The facility is a large containment vessel originally intended to test the EGCR. Large, contained, and shielded spaces are available for testing, assembly, disassembly, and post-test examination.

3026 (CTA-IEAV-RI–007/89) **Development of a spatial nuclear electric system: RESPA sub-project.** Ishiguro, Y. Centro Tecnico Aeroespacial (CTA-IEAv), Sao Jose dos Campos, SP (Brazil). Inst. de Estudos Avancados. Apr 1989. 41p. (In Portuguese). Order Number DE93607823. Source: OSTI; NTIS (US Sales Only); INIS.

Basic design and characteristics of a nuclear-electric system selected for future applications in the Brazilian space program is summarized. Technological difficulties are discussed and a preliminary program of research and development at IEAv is presented. (author).

3027 (INIS-BR–3036) **Study on transient of fluidized bed nuclear reactor.** Streck, E.E. Rio Grande do Sul Univ., Porto Alegre, RS (Brazil). Escola de Engenharia. 1988 91p. (In Portuguese). Order Number DE93607824. Source: OSTI; NTIS (US Sales Only); INIS.

The point kinetic equations for a Fluidized-Bed Nuclear Reactor are solved by the method of Hansen. Due to the time varying nature of the reactor volume, the equations have a non-conventional formulation (moving boundary problem), but the method of solution preserves its asymptotic convergence and efficiency characteristics under this formulation. A one dimensional and linearized thermal hydraulics feedback model was coupled to the point kinetic equations in order to obtain a more realistic representation of the reactor power. The resulting equations are solved by the Euler explicit method. (author).

3028 (KAPL–4736) **Knolls Atomic Power Laboratory annual environmental monitoring report, Calendar year 1991.** Knolls Atomic Power Lab., Schenectady, NY (United States). [1991]. 120p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC12-76SN00052. Order Number DE93000356. Source: OSTI; NTIS; INIS; GPO Dep.

The results of the effluent and environmental monitoring programs at the three Knolls Atomic Power Laboratory (KAPL) sites are summarized and assessed in this report. Operations at the three KAPL sites resulted in no significant release of hazardous substances or radioactivity to the environment. The effluent and environmental monitoring programs conducted by KAPL are designed to determine the effectiveness of treatment and control methods, to provide measurement of the concentrations in effluents for comparison with applicable standards, and to assess resultant concentrations in the environment. The monitoring programs include analyses of samples of liquid and gaseous effluents for chemical constituents and radioactivity as well as monitoring of environmental air, water, sediment, and fish. Radiation measurements are also made around the perimeter of each site and at off-site background locations.

3029 (LA-UR–92-848) **Survivability tests of foil and screen wicked niobium-1% zirconium/potassium heat pipes.** Sena, J.T.; Merrigan, M.A. Los Alamos National Lab., NM (United States). [1992]. 7p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. (CONF-930108–1: 31. American Institute of Astronautics and Aeronautics (AIAA) aerospace sciences meeting, Reno, NV (United States), 11-14 Jan 1993). Order Number DE92011366. Source: OSTI; NTIS (US Sales Only); GPO Dep.

Laser threat simulation tests have been conducted on two Niobium–2% Zr heat pipes that used potassium as the working fluid. One of the heat pipes used a multilayer etched foil as the wick, and the other used a composite screen as the wick. Both wicks were annular in design. The foil-wicked heat pipe was found to be extremely sensitive to tilt angle in threat response performance, while the screen-wicked heat pipe was more stable in performance and was able to sustain a higher threat input flux. Both heat pipes were capable of recovery from simulated threat inputs greater than 10 W/cm^2. The heat pipes were tested in a vacuum chamber. They were heated with RF induction heating, both at the evaporator end and at the condenser/threat region. Type K thermocouples were attached to the heat pipes for measuring temperature. Performance was recorded from steady state initial conditions through the simulated threat and recovery.

3030 (LA-UR–92-1624) **Experimental and numerical optimization of the U-Zr-C ternary phase diagram.** Butt, D.P.; Wallace, T.C.; Stark, W.A. Jr; Storms, E.K.; Hampel, F.G.; Williamson, M.A.; Kleinschmidt, P.D. Los Alamos National Lab., NM (United States). [1992]. 17p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. (CONF-930103–1: 10. symposium on space nuclear power and propulsion, Albuquerque, NM (United States), 10-14 Jan 1993). Order Number DE92015242. Source: OSTI; NTIS; GPO Dep.

The U-Zr-C ternary-phase diagram is optimized using melting point and vapor pressure data recently measured at Los Alamos National Laboratory and by graphical and numerical curve fitting of self-consistent thermodynamic and phase diagram data reported in the literature. The system is described from 2473 K to 3693 K using isothermal ternary phase diagrams. The solidus and liquidus curves of the $U_xZr_{1-x}C_y$ solid solution were estimated from combined thermodynamic and adjusted phase diagram data. From the solidus and liquidus curves for the solid solution, the reversible heat transferred from the solid to the liquid phase for UC and ZrC were calculated to be 150 and 324 kJ/mol, respectively; and the maximum in the excess free energy for mixing was determined to be on the order of 1100 J/mol at 56% ZrC.

3031 (PNL-SA–20524) **An integrated mission planning approach for the Space Exploration Initiative.** Coomes, E.P.; Dagle, J.E.; Bamberger, J.A.; Noffsinger, K.E. Pacific Northwest Lab., Richland, WA (United States). Aug 1992. 4p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. (CONF-9208114–5: American Nuclear Society meeting, Jackson Hole, WY (United States), 16-19 Aug 1992). Order Number DE93001512. Source: OSTI; NTIS; INIS; GPO Dep.

This report discusses a fully integrated energy-based approach to mission planning which is needed if the Space Exploration Initiative (SEI) is to succeed. Such an approach would reduce the number of new systems and technologies requiring development. The resultant horizontal commonality of systems and hardware would reduce the direct economic impact of SEI and provide an economic benefit by greatly enhancing our international technical competitiveness through technology spin-offs and through the resulting early return on investment. Integrated planning and close interagency cooperation must occur if the SEI is to achieve its goal of expanding the human presence into the solar system and be an affordable endeavor. An energy-based mission planning approach gives each mission planner the needed power, yet preserves the individuality of mission requirements and objectives while reducing the concessions mission planners must make. This approach may even expand the mission options available and enhance mission activities.

3032 (SAND–92-1207C) **An in-pile testing program to study the performance characteristics of coated particle fuels.** Wright, S.A. Sandia National Labs., Albuquerque, NM (United States). [1992]. 7p. Sponsored by Department of Defense, Washington, DC (United States). DOE Contract AC04-76DP00789. (CONF-930103–6: 10. symposium on space nuclear power and propulsion, Albuquerque, NM (United States), 10-14 Jan 1993). Order Number DE92018823. Source: OSTI; NTIS; GPO Dep.

Sandia National Laboratories is actively involved in testing coated particle nuclear fuels for the Space Nuclear Thermal Propulsion (SNTP) program managed by Phillips Laboratory. The testing program integrates the results of numerous in-pile and out-of-pile tests with modeling efforts to qualify fuel and fuel elements for the SNTP program. This paper briefly describes the capabilities of the Annular Core Research Reactor (in which the experiments are performed), the major in-pile tests, and the models used to determine the performance characteristics of the fuel and fuel elements. 6 refs.

3033 (SAND–92-1407C) **A critical assembly designed to measure neutronic benchmarks in support of the Space Nuclear Thermal Propulsion program.** Parma, E.J. (Sandia National Labs., Albuquerque, NM (United States)); Ball, R.M.; Hoovler, G.S.; Selcow, E.C.; Cerbone, R.J. Sandia National Labs., Albuquerque, NM (United States). [1992]. 10p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-76DP00789. (CONF-930103–12: 10. symposium on space nuclear power and propulsion, Albuquerque, NM (United States), 10-14 Jan 1993). Order Number DE92040974. Source: OSTI; NTIS (US Sales Only); GPO Dep.

A reactor designed to perform criticality experiments in support of the Space Nuclear Thermal Propulsion program is currently in operation at the Sandia National Laboratories' reactor facility. The reactor is a small, water-moderated system that uses highly enriched uranium particle fuel in a 19-element configuration. Its

purpose is to obtain neutronic measurements under a variety of experimental conditions that are subsequently used to benchmark reactor-design computer codes. Brookhaven National Laboratory, Babcock & Wilcox, and Sandia National Laboratories participated in determining the reactor's performance requirements, design, follow on experimentation, and in obtaining the licensing approvals. Brookhaven National Laboratory is primarily responsible for the analytical support, Babcock & Wilcox the hardware design, and Sandia National Laboratories the operational safety. All of the team members participate in determining the experimentation requirements, performance, and data reduction. Initial criticality was achieved in October 1989. An over-all description of the reactor is presented along with key design features and safety-related aspects.

2107 Regulation and Licensing

Refer also to citation(s) 3016, 3017, 3121, 3304, 3442

3034 (CNEN-DR–141/88) **Authorization for the use of nuclear material. IPEN/MB-01 critical unit.** Comissao Nacional de Energia Nuclear (CNEN), Rio de Janeiro, RJ (Brazil). Dept. de Reatores. Nov 1988. 12p. (In Portuguese). Order Number DE93608102. Source: OSTI; NTIS (US Sales Only); INIS.

A set of reports concerning the authorization for use and control of nuclear material at IPEN/MB - 01 critical unit is presented. (A.C.A.S.).

3035 (NUREG–0750-Vol.35-Index2) **Indexes to Nuclear Regulatory Commission Issuances, January–June 1992: Volume 35, Index 2.** Nuclear Regulatory Commission, Washington, DC (United States). Div. of Freedom of Information and Publications Services. Sep 1992. 47p. Sponsored by Nuclear Regulatory Commission, Washington, DC (United States). Source: OSTI; NTIS; INIS; GPO.

Digests and indexes for insurances of the Commission (CLI), the Atomic Safety and Licensing Board Panel (LBP), the Administrative Law Judges (ALJ), the Directors' Decisions (DD), and the Denials of Petitions for Rulemaking (DPRM) are presented in this document. These information elements are displayed in one or more of five separate formats arranged as follows: Case name index; digests and headers; legal citations index; subject index; and facility index.

2108 Economics

Refer also to citation(s) 2634, 2644, 2647, 2649, 2722, 3007, 3485, 3486, 3494

3036 (IAEA-TECDOC–650, pp. 35-42) **Economic target modelling in exploration: Methodology and case study of the western part of the Athabasca Basin, Canada.** Gatzweiler, R. (Uranerzbergbau GmbH, Wesseling (Germany)); Vels, B.; Braun, R. International Atomic Energy Agency, Vienna (Austria); Nuclear Energy Agency, 75 - Paris (France). Jun 1992. (CONF-9108224–: Technical committee meeting on new developments in uranium exploration, resources, production and demand, Vienna (Austria), 26-29 Aug 1991). In *New developments in uranium exploration, resources, production and demand: Proceedings of a technical committee meeting held in Vienna, 26-29 August 1991.* 258p. Order Number DE93607128. Source: OSTI; NTIS (US Sales Only); INIS.

Economic evaluations using the methods of Discounted Cash Flow (DCF) - analysis are standard practice for advanced projects in the mineral industry. Exploration can be regarded in a broader economic sense as an investment activity aiming at the definition of profitable investment possibilities for a mining company. Success in exploration is dependent amongst other factors on a continuous availability of risk capital which is always in short supply. The methodology is further explained by a case study which evaluates a modelled project at the western rim of the Athabasca Basin. Comparisons are drawn with advanced projects at the eastern rim of the Basin. One aim of this paper is to show that an economic evaluation is a powerful tool at all project stages: beginning at the armchair stage, guiding the exploration phase until the final feasibility and investment decision. 6 refs, 7 figs.

3037 (IAEA-TECDOC–650, pp. 89-104) **Uranium supply-demand projections and their analyses.** Giroux, M. (Compagnie Generale des Matieres Nucleaires (COGEMA), 78 - Velizy-Villacoublay (France)); Mueller-Kahle, E.; Pecnik, M.; Soyer, B.; Underhill, D.H. International Atomic Energy Agency, Vienna (Austria); Nuclear Energy Agency, 75 - Paris (France). Jun 1992. (CONF-9108224–: Technical committee meeting on new developments in uranium exploration, resources, production and demand, Vienna (Austria), 26-29 Aug 1991). In *New developments in uranium exploration, resources, production and demand: Proceedings of a technical committee meeting held in Vienna, 26-29 August 1991.* 258p. Order Number DE93607128. Source: OSTI; NTIS (US Sales Only); INIS.

The paper presents three uranium supply-demand projections, through 2005, 2020 and 2035 using different approaches and resource data. For the time through 2005, an adjusted Red Book approach is used, which compares the reactor related requirements with the expected future producing including estimated imports from non-WOCA sources. For the second period, through 2020, the methodology applied by Nuclear Assurance Corporation is used, which projects supply for two demand scenarios from firm projects and firm plus potential projects of its database, by full cost category. The third approach, through 2035, uses the RAPP 3 computer supply simulation for the same demand scenarios both by producer country and resource category. The results from the different exercises for overlapping time periods coincide well as regards the drawdown of current stocks, the need for additional production centres as well as the sufficiency of known uranium resources. The consequences for uranium exploration and resource development are discussed. (author). 11 refs, 12 figs, 4 tabs.

3038 (IAEA-TECDOC–650, pp. 104-115) **Thorium deposits and their availability.** Barthel, F.H. (Bundesanstalt fuer Geowissenschaften und Rohstoffe, Hannover (Germany)). International Atomic Energy Agency, Vienna (Austria); Nuclear Energy Agency, 75 - Paris (France). Jun 1992. (CONF-9108224–: Technical committee meeting on new developments in uranium exploration, resources, production and demand, Vienna (Austria), 26-29 Aug 1991). In *New developments in uranium exploration, resources, production and demand: Proceedings of a technical committee meeting held in Vienna, 26-29 August 1991.* 258p. Order Number DE93607128. Source: OSTI; NTIS (US Sales Only); INIS.

Thorium deposits are known from a number of countries and occur in a variety of geological environments. This paper gives a summary of the authors attempt to classify thorium deposits independent of their economic significance. The deposits which occur in igneous, metamorphic and sedimentary rocks are further subdivided according to their geological setting and type of host rock. Significant thorium resources are found to be associated with carbonatite rocks (40% of total known resources), mainly in those rich in niobium and rare earth elements. The second important type are vein deposits (31% of known resources) where thorium occurs both in separate thorium minerals or in rare earth minerals. Next to vein deposits placers (unconsolidated beach placers and consolidated paleo-placers) account for 19% of the known resources. Within this type thorium bearing minerals (mainly monazite) can be recovered as by-product of heavy mineral production (cassiterite, ilmenite etc.). Other deposits, such as pegmatites or alkaline intrusives are of minor importance. In a speculative order of economic importance the deposits can be classified as follows: (1) unconsolidated placers, (2) consolidated paleo-placers, (3) veins, (4) carbonatites. The total world output of thorium is estimated at around 400 t ThO_2 out of which only a portion is presently used. If commercial demand would increase due to wider application, e.g. in thorium fueled nuclear power plants annually around 2000 t ThO_2 could be made available by extraction from monazite concentrates recovered as by-product of heavy mineral mining. This paper is a summary of a publication of the same authors in Gmelin Handbook of Inorganic and Organometallic Chemistry, Thorium, Supplement Volume A1b published by Springer Verlag 1991. (author). 20 refs, 4 figs, 5 tabs.

3039 (Juel–2638) **Investigations of investment risk analysis for new reactor design approaches.** Mueller-Spaeth, H. Forschungszentrum Juelich GmbH (Germany). Inst. fuer Sicherheitsforschung und Reaktortechnik; Technische Hochschule Aachen (Germany). Jul 1992. 221p. (In German). Order Number DE93728943. Source: OSTI; NTIS (US Sales Only); INIS.

This work investigates aspects of investment risk that attaches the utility view during operation lifetime of the plant. First characteristic parameters are developed to quantify IR which is caused by unplanned outage times and their coupled unavailability. Also a loss of plant after serious events can be considered. With empirical methods unplanned outages of British AGRs and German PWRs (1300 MW) are evaluated that occured between 1975 and 1985. Analytical methods are needed for rare outages. Possible events of the medium size reactor HTR-500 are exemplarily considered with these methods. Only qualitative reflections are performed for small size reactors HTR-100 and HTR-Modul. Finally criterias are presented that should deliver a contribution to include aspects of investment risk into PRA. (orig.).

22 NUCLEAR REACTOR TECHNOLOGY

2201 Theory and Calculation

Refer also to citation(s) 3072, 3115, 3122, 3126, 3172, 3290, 3917, 4641, 4646, 4791, 4793, 4794

3040 (ANL/RA/CP–77609) **R-matrix parameters in reactor applications.** Hwang, R.N. Argonne National Lab., IL (United States). [1992]. 15p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-31109-ENG-38. (CONF-921046–2: Symposium on nuclear data evaluation methodology, Upton, NY (United States), 12-16 Oct 1992). Order Number DE93001679. Source: OSTI; NTIS; INIS; GPO Dep.

The key role of the resonance phenomena in reactor applications manifests through the self-shielding effect. The basic issue involves the application of the microscopic cross sections in the macroscopic reactor lattices consisting of many nuclides that exhibit resonance behavior. To preserve the fidelity of such a effect requires the accurate calculations of the cross sections and the neutron flux in great detail. This clearly not possible without viable resonance data. Recently released ENDF/B VI resonance data in the resolved range especially reflect the dramatic improvement in two important areas; namely, the significant extension of the resolved resonance ranges accompanied by the availability of the R-matrix parameters of the Reich-Moore type. Aside from the obvious increase in computing time required for the significantly greater number of resonances, the main concern is the compatibility of the Riech-Moore representation to the existing reactor processing codes which, until now, are based on the traditional cross section formalisms. This purpose of this paper is to summarize our recent efforts to facilitate implementation of the proposed methods into the production codes at ANL.

3041 (BNL-NUREG–47882) **An overview of reactor physics standards: Past, present and future.** Cokinos, D.M. Brookhaven National Lab., Upton, NY (United States). Jul 1992. 8p. Sponsored by Nuclear Regulatory Commission, Washington, DC (United States). DOE Contract AC02-76CH00016. (CONF-921102–21: Joint American Nuclear Society (ANS)/European Nuclear Society (ENS) international meeting on fifty years of controlled nuclear chain reaction: past, present, and future, Chicago, IL (United States), 15-20 Nov 1992). Order Number DE93001434. Source: OSTI; NTIS; INIS; GPO Dep.

This report discusses for determining key static reactor physics parameters which have been developed by groups of experts (working groups) under the aegis of ANS-19, the ANS Reactor Physics Standards Committee. Following a series of sequential reviews, augmented by feedback from potential users, a proposed standard is brought into final form by the working group before it is adopted as a formal standard by the American National Standards Institute (ANSI); Reactor Physics standards are intended to provide guidance in the performance and qualification of complex sequences of reactor calculations and/or measurements and are regularly reviewed for possible updates and/or revisions. The reactor physics standards developed to date are listed and standards now being developed by the respective working groups are also provided.

3042 (CTA-IEAV-NT–005/92) **ALEXS1 and ALEXS2: two interfaces between the ENDF-6 library and the GROUPXS program.** Caldeira, A.D. Centro Tecnico Aeroespacial (CTA-IEAv), Sao Jose dos Campos, SP (Brazil). Inst. de Estudos Avancados. Aug 1992. 8p. (In Portuguese). Order Number DE93607640. Source: OSTI; NTIS (US Sales Only); INIS.

Two interfaces that modify files 3 and 6 of the ENDF-6 library to permit processing these data by the GROUPXS program are presented. (author).

3043 (CTA-IEAV-RI–006/92) **A coupling between BURN and ANISN computer code.** Caldeira, A.D. Centro Tecnico Aeroespacial (CTA-IEAv), Sao Jose dos Campos, SP (Brazil). Inst. de Estudos Avancados. Jul 1992. 15p. (In Portuguese). Order Number DE93607700. Source: OSTI; NTIS (US Sales Only); INIS.

The procedures utilized for coupling programs BURN and ANISN are described. (author).

3044 (IEN–35/92) **Numerical solution of reactor kinetics equations using the Alternating Direction Explicit (ADE) method.** Santos, R.S. dos. Instituto de Engenharia Nuclear (IEN), Rio de Janeiro, RJ (Brazil). Feb 1992. 61p. (In Portuguese). Order Number DE93607641. Source: OSTI; NTIS (US Sales Only); INIS.

In the work the one - and two - dimensional reactor kinetics equations in the multigroup diffusion theory is spatially discretized. The Alternating Direction Explicit (ADE) method is used to solve the resulting system of discretized equations. This numerical scheme is used to investigate several transients in one - and two - dimensional geometries. The results shown good qualitative and quantitative agreements with the results generated in different references. (author).

3045 (INIS-BR–2975) **Obtainment of nuclear power plant dynamic parameters by adaptive mesh technique.** Carvalho Miranda, W. de. Instituto Militar de Engenharia (IME), Rio de Janeiro, RJ (Brazil). 1979 92p. (In Portuguese). Order Number DE93607642. Source: OSTI; NTIS (US Sales Only); INIS.

This thesis involves the problem in determination of the parameters of the Mathematical Model of a Nuclear Reactor, including non-linearity which is considered as a bi-linear system. Being a non-linear model, the determination of its parameters cannot be made with the classical techniques as in obtaining its experimental frequency response. In the present work, we examine the possibility of using a model with parameters that adapt according to a algorithm of Newton type minimization, showing that in the case of the single parameter determination, the method is successful. This work was done, using the CSMP (Continuous System Modelling Program) of IBM 1130 of IME. (author).

3046 (INIS-BR–2977) **Feasibility study on heterogeneous method in criticality calculations.** Prati, A. Instituto Militar de Engenharia (IME), Rio de Janeiro, RJ (Brazil). 1977 81p. (In Portuguese). Order Number DE93607643. Source: OSTI; NTIS (US Sales Only); INIS.

The criticality of finite heterogeneous assemblies is analysed by the heterogeneous methods employing the Eigen-function analysis. The moderation is treated by the Fermi age theory. The system is analysed in two dimensional rectangular coordinates. The criticality and the fluxes are determined for systems with small and large number of fuel rods. The convergence and the residual error in the modal analysis are discussed. (author).

3047 (INIS-BR–3058) **Methodological study of the adjustment of multigroup cross sections for fast reactors, by means of integral data.** Bastos, H.F.B.N. Universidade Federal, Rio de Janeiro, RJ (Brazil). Coordenacao dos Programas de Posgraduacao de Engenharia. 1979 114p. (In Portuguese). Order Number DE93607645. Source: OSTI; NTIS (US Sales Only); INIS.

In this work a study of the methodology of the adjustment of multigroup cross sections by means of integral data is presented. A synthesis of the principal methods existent and the mathematical

development of the adaptation of one of them are made. A calculational system is built from this reference method, with the basic conditions for the operation of the process of adjustment. In order to test the system developed and analyze several problems related to the adjustment, a series of trial adjustments was made with the value of the U^{235} fission cross section from the infinite dilution library used in the calculational system for fast reactors of the Instituto de Engenharia Nuclear. (author).

3048 (INIS-mf–13375, pp. 2-3) **Studying the possibility of increasing the fast neutron flux in the HC no. 5.** Aboustta, M. (Tajoura Nuclear Research Centre, Tajoura (Libya)); Gashot, A. Tajoura Nuclear Research Centre, Tripoli (Libyan Arab Jamahiriya). 1984. 82p. (CONF-8409421–: Seminar on the use of research reactors in fundamental and applied sciences, Tajoura (Libyan Arab Jamahiriya), 16 Sep 1984). In *Seminar on the use of research reactors in fundamental and applied sciences. Programme and abstracts.* Order Number DE93606515. Source: Also available from Tajoura Nuclear Research Centre, Tajoura/Tripoli, Libya.

Short communication. REACTOR CHANNELS/neutron flux; FAST NEUTRONS; NEUTRON REFLECTORS; SHIM RODS; THERMAL NEUTRONS

2202 Components and Accessories

Refer also to citation(s) 3101, 3111, 3297, 3301, 3401, 3434, 3443, 3586, 3603, 3963, 4645

3049 (EGG-HFRU–10214) **Nuclear Computerized Library for Assessing Reactor Reliability (NUCLARR): Version 3.5, Quick Reference Guide.** Gilbert, B.G.; Richards, R.E.; Reece, W.J.; Gertman, D.I. EG and G Idaho, Inc., Idaho Falls, ID (United States). Oct 1992. 164p. Sponsored by Nuclear Regulatory Commission, Washington, DC (United States). DOE Contract AC07-76ID01570. Order Number DE93001962. Source: OSTI; NTIS; GPO Dep.

This Reference Guide contains instructions on how to install and use Version 3.5 of the NRC-sponsored Nuclear Computerized Library for Assessing Reactor Reliability (NUCLARR). The NUCLARR data management system is contained in compressed files on the floppy diskettes that accompany this Reference Guide. NUCLARR is comprised of hardware component failure data (HCFD) and human error probability (HEP) data, both of which are available via a user-friendly, menu driven retrieval system. The data may be saved to a file in a format compatible with IRRAS 3.0 and commercially available statistical packages, or used to formulate log-plots and reports of data retrieval and aggregation findings.

3050 (NUREG–1377-Rev.3) **NRC research program on plant aging: Listing and summaries of reports issued through July 1992: Revision 3.** Kondic, N.N. Nuclear Regulatory Commission, Washington, DC (United States). Div. of Engineering. Sep 1992. 107p. Sponsored by Nuclear Regulatory Commission, Washington, DC (United States). Source: OSTI; NTIS; INIS; GPO.

The US Nuclear Regulatory Commission is conducting the Nuclear Plant Aging Research (NPAR) Program. This is a comprehensive hardware-oriented engineering research program focused on understanding the aging mechanisms of components and systems in nuclear power plants. The NPAR program also focuses on methods for simulating and monitoring the aging-related degradation of these components and systems. In addition, it provides recommendations for effective maintenance to manage aging and for implementation of the research results in the regulatory process. This document contains a listing and index of reports generated in the NPAR Program that were issued through July 1992 and summaries of those reports. Each summary describes the elements of the research covered in the report and outlines the significant results. For the convenience of the user, the reports are indexed by personal author, corporate author, and subject.

3051 (NUREG/CR–5913-Vol.1) **Irradiation effects on fracture toughness of two high-copper submerged-arc welds, HSSI Series 5: Volume 1, Main report and Appendices A, B, C, and D.** Nanstad, R.K. (Oak Ridge National Lab., TN (United States)); Haggag, F.M.; McCabe, D.E.; Iskander, S.K.; Bowman, K.O.; Menke, B.H. Nuclear Regulatory Commission, Washington, DC (United States). Div. of Engineering; Oak Ridge National Lab., TN (United States). Oct 1992. 162p. Sponsored by Nuclear Regulatory Commission, Washington, DC (United States). DOE Contract AC05-84OR21400. (ORNL/TM–12156/V1). Source: OSTI; NTIS; INIS; GPO.

The Fifth Irradiation Series in the Heavy-Section Steel Irradiation Program obtained a statistically significant fracture toughness data base on two high-copper (0.23 and 0.31 wt %) submerged-arc welds to determine the shift and shape of the K_{Ic} curve as a consequence of irradiation. Compact specimens with thicknesses to 101.6 mm (4 in) in the irradiated condition and 203.2 mm (8 in) in the unirradiated condition were tested, in addition to Charpy impact, tensile, and drop-weight specimens. Irradiations were conducted at a nominal temperature of 288°C and an average fluence of 1.5×10^{19} neutrons/cm^2 (>I MeV). The Charpy 41-J temperature shifts are about the same as the corresponding drop-weight NDT temperature shifts. The irradiated welds exhibited substantial numbers of cleavage pop-ins. Mean curve fits using two-parameter (with fixed intercept) nonlinear and linearized exponential regression analysis revealed that the fracture toughness 100 MPa•$\sqrt{m}$ shifts exceeded the Charpy 41-J shifts for both welds. Analyses of curve shape changes indicated decreases in the slopes of the fracture toughness curves, especially for the higher copper weld. Weibull analyses were performed to investigate development of lower bound curves to the data, including the use of a variable K_{min} parameter which affects the curve shape.

3052 **Duplex sampling apparatus and method.** Brown, P.E.; Lloyd, R. To Dept. of Energy. 30 Jan 1991. USAA patent application 7-647,96. 18p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC11-89PN38014. Order Number DE93001992. Source: OSTI; NTIS; GPO Dep.

An improved apparatus is provided for sampling a gaseous mixture and for measuring mixture components. The apparatus includes two sampling containers connected in series serving as a independently determine the amounts of condensable and noncondensable gases in admixture from a single sample. More specifically, a first container includes a first port capable of selectively connecting to and disconnecting from a sample source and a second port capable of selectively connecting to and disconnecting from a second container. A second container also includes a first port capable of selectively connecting to and disconnecting from the second port of the first container and a second port capable of either selectively connecting to and disconnecting from a differential pressure source. By cooling a mixture sample in the first container, the condensable vapors form a liquid, leaving noncondensable gases either as free gases or dissolved In the liquid. The condensed liquid is heated to drive out dissolved noncondensable gases, and all the noncondensable gases are transferred to the second container. Then the first and second containers are separated from one another in order to separately determine the amount of noncondensable gases and the amount of oondensable gases in the sample.

3053 **High flexibility, noncollapsing light weight hose.** Williams, D.A. To Dept. of Energy. 1 Feb 1991. USAA patent application 7-648,93. 11p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC11-76PN00014 ;AC11-89PN38014. Order Number DE93001993. Source: OSTI; NTIS; GPO Dep.

This invention relates generally to a high-flexibility, light weight, noncollapsing hose and more particularly to such a hose having a large size and particularly useful as equipment draining a radioactively contaminated fluid through a noncontaiminated, isolated and restricted space with high confidence against kinking, collapse, or leaking even with large relative motion between the inlet and outlet ends of the hose. In the operation of nuclear facilities, such as nuclear reactors, processing plants for nuclear fuels and related materials, and chemical processing plants, for example, it is necessary to handle radioactively and/or chemically contaminated fluids which in many instances must be conducted, such as for draining purposes, through a noncontaminated, isolated and area. Conduction of such contaminated fluids through uncontaminated environments in practice requires the highest confidence that the hose will not kink, collapse, break, or leak even though the hose

may be subject to a large amount of motion relative to the inlet and outlet ends of the hose. Any such breaking, or leaking would result in undesirable contamination of the area through which the hose passes which could result in major damage and/or in the requirement to shut down the operation for cleanup and decontamination processing of the area. Additional problems are also encountered in processing plants for contaminated materials due to the fact that hoses conducting the contaminated liquids or gases pass through inaccessible, restricted spaces requiring extreme flexibility in the hose!, but with the assurance that the hose will neither kink nor collapse to close off the flow.

3054 **Fluid flow monitoring device.** McKay, M.D.; Sweeney, C.E. To Dept. of Energy. 5 Mar 1991. USAA patent application 7-664,71. 13p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC09-89SR18035. Order Number DE93002012. Source: OSTI; NTIS; GPO Dep.

This invention consists of a flow meter and temperature measuring device comprising a tube with a body centered therein for restricting flow and a sleeve at the upper end of the tube to carry several channels formed longitudinally in the sleeve to the appropriate axial location where they penetrate the tube to allow pressure measurements and temperature measurements with thermocouples. The high pressure measurement is made using a channel penetrating the tube away from the body and the low pressure measurement is made at a location at the widest part of the body. An end plug seals the end of the device and holes at its upper end allow fluid to pass from the interior of the tube into a plenum. The channels are made by cutting grooves in the sleeve, the grooves widened at the surface of the sleeve and then a strip of sleeve material is welded to the grooves closing the channels. Preferably the sleeve is packed with powdered graphite before cutting the grooves and welding the strips.

3055 (VTT-PUB–94) **Probabilistic methods in nuclear power plant component ageing analysis.** Simola, K. (Technical Research Centre of Finland, Espoo (Finland). Lab. of Electrical and Automation Engineering). Technical Research Centre of Finland, Espoo (Finland). Mar 1992. 83p. Order Number DE93607652. Source: OSTI; NTIS; INIS.

The nuclear power plant ageing research is aimed to ensure that the plant safety and reliability are maintained at a desired level through the designed, and possibly extended lifetime. In ageing studies, the reliability of components, systems and structures is evaluated taking into account the possible time- dependent decrease in reliability. The results of analyses can be used in the evaluation of the remaining lifetime of components and in the development of preventive maintenance, testing and replacement programmes. The report discusses the use of probabilistic models in the evaluations of the ageing of nuclear power plant components. The principles of nuclear power plant ageing studies are described and examples of ageing management programmes in foreign countries are given. The use of time-dependent probabilistic models to evaluate the ageing of various components and structures is described and the application of models is demonstrated with two case studies. In the case study of motor- operated closing valves the analysis are based on failure data obtained from a power plant. In the second example, the environmentally assisted crack growth is modelled with a computer code developed in United States, and the applicability of the model is evaluated on the basis of operating experience.

3056 (WSRC-MS–92-293) **Resistance upset welding for vessel fabrication.** Kanne, W.R. Jr. Westinghouse Savannah River Co., Aiken, SC (United States). [1992]. 16p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC09-89SR18035. (CONF-9209237–1: JOWOG 22D meeting, Aldermaston (United Kingdom), 29 Sep - 2 oct 1992). Order Number DE93000389. Source: OSTI; NTIS; GPO Dep.

Solid-state resistance upset welding has been successfully applied to fabrication of small vessels. The process has advantages compared with the fusion welding processes currently used to join the two halves of such vessels. These advantages result from the improved metallurgical properties of the weld zone and the simplicity of the welding process. Spherical and cylindrical shapes have been fabricated using the upset welding process. Nondestructive and destructive tests have shown excellent weld strength. Storage tests have demonstrated long term compatibility of the welds for cylindrical parts made from 304L stainless steel that have been in storage for eight years. Spherical vessels and reinforced desip vessels made from forged 21-6-9 stainless steel have been prepared for storage.

2203 Fuel Elements

Refer also to citation(s) 3102, 3116, 3170, 3220, 3221, 3222, 3223, 3224, 3225, 3226, 3227, 3228, 3229, 3230, 3231, 3232, 3233, 3234, 3235, 3236, 3237, 3238, 3239, 3240, 3241, 3242, 3243, 3244, 3245, 3246, 3247, 3248, 3249, 3250, 3251, 3252, 3253, 3254, 3255, 3256, 3257, 3258, 3259, 3260, 3261, 3262, 3263, 3264, 3265, 3266, 3267, 3268, 3269, 3278, 4802

3057 (DPW–5471) **New fuel element development: properties of uranium-zirconium alloys.** Huntoon, R.T. Du Pont de Nemours (E.I.) and Co., Wilmington, DE (United States). Explosives Dept. 21 May 1952. 9p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC09-76SR00001. (SR/H–230). Order Number DE93001463. Source: OSTI; NTIS (US Sales Only); GPO Dep.

This is a brief review of the properties of uranium-zirconium alloys of interest in neutron producers. Its purpose is to provide information on which to base preliminary calculations for the design of flat fuel element assemblies. The best available data are, given on the phase diagram, density, specific heat, hardness, irradiation behavior, thermal behavior, and chemical behavior of uranium-zirconium alloys. In each of these cases either experimental data are available or reasonable approximations have been made. A more complete tabulation will be made when the results of the experimental program at BMI become available.

3058 (DPW–6761) **A review of means for encasing uranium in aluminum.** Rhines, F.N. (Carnegie Inst. of Tech., Pittsburgh, PA (United States)). Du Pont de Nemours (E.I.) and Co., Wilmington, DE (United States). Explosives Dept. 13 Nov 1952. 33p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC09-76SR00001. (SR/H–249). Order Number DE93002376. Source: OSTI; NTIS (US Sales Only); GPO Dep.

A brief appraisal is given of possible methods for attaching a protective layer of aluminum to uranium: deformation cladding (roll, die, extruded casing), cast (dip, weld metal, spray, arc), vapor deposition (vapor coating, sputtering, CVD), electrodeposition (plating, displacement/cementation), diffused (calorizing, autogenous welding), attachment by fusion layer (brazed, soldering, mercury bonding), sintered, and chemical displacement. The kinds of deterioration that must be prevented by the coating are considered. It is assumed that adequate corrosion resistance requires a $\sim$ 0.040-in. thick Al layer firmly contacted or bonded to the uranium. The "AlSi" process for canning cylindrical slugs is not discussed. The conclusion is that the best method is among the deformation cladding processes, roll cladding for flat shapes and die cladding for cylindrical shapes.

3059 (IAEA-TECDOC–660, pp. 205-213) **The development of expert systems for process monitoring in British nuclear fuels.** Wilson, T. (British Nuclear Fuels plc, Sellafield (United Kingdom)); Harper, W.; Bates, P. International Atomic Energy Agency, Vienna (Austria). Jul 1992. (CONF-9109435–: Technical committee meeting/workshop on demonstration and review of expert system prototypes, Springfields (United Kingdom), 30 Sep 1991). In *Expert systems in the nuclear industry: Report of a technical committee meeting/workshop held in Springfields, United Kingdom, 30 September - 4 October 1991.* 219p. Order Number DE93606682. Source: OSTI; NTIS (US Sales Only); INIS.

British Nuclear Fuels plc (BNFL) is the most experienced nuclear fuel company in the world, having supplied nuclear fuel cycle services in the UK and overseas for over 40 years. It is one of only two companies in the world that is able to offer nuclear fuel manufacture, enrichment, reprocessing and waste management services. BNFL became involved in the development of the application of Expert Systems technology for the monitoring of process plants, during 1983. This work has culminated in the installation of

operational systems at Sellafield, Springfields and Capenhurst, and has put BNFL in a strong position to further exploit the technology in future. This paper describes the development work which has been undertaken to date and the role of the installed systems. 10 refs, 2 figs.

3060 (KAERI/AR–335/91) **Development of hold-down spring for high burn-up fuel assembly.** Lee, Jae Kyung (Korea Atomic Energy Research Inst., Daeduk (Korea, Republic of)). Korea Atomic Energy Research Inst., Daeduk (Korea, Republic of). Dec 1991. 52p. (In Korean). Order Number DE93607669. Source: OSTI; NTIS (US Sales Only); INIS.

For the development of high burn-up fuel assembly, it is necessary to develop hold-down spring which guarantees more gap margin between fuel rods and end pieces, and also provides more hold-down force at EOL than current hold-down spring. To this end, the development of the analysis method which considers the effect of friction between leaves and that of spring screw and top end piece, the design method for obtaining the optimal design parameters from the given spring characteristic curve, the design method for improved manufacturability and the technology for spring characteristic test are required. In this report, basic design features and the domestic and foreign design status of hold-down spring, and the direction for the development of hold-down spring for high burn-up fuel assembly are presented. (Author).

3061 (KAERI/RR–1024/91) **Development of nuclear fuels. Development of post-irradiation examination and evaluation techniques for nuclear reactor fuel (II).** Ro, Seung Gy (Korea Atomic Energy Research Inst., Daeduk (Korea, Republic of)); Kim, Eun Ka; Min, Duk Kee. Korea Atomic Energy Research Inst., Daeduk (Korea, Republic of). Sep 1991. 159p. (In Korean). Order Number DE93607670. Source: OSTI; NTIS (US Sales Only); INIS.

Spent PWR fuel assembly with a discharge burnup of 37.84 GWD/MTU, which was irradiated for 3-reactor cycles in the Kori-1 nuclear power plant(NPP) has been transported via road to the KAERI's PIE facility. In-pool nondestructive examination for the fuel assembly with a discharge burnup of 35.50 GWD/MTU, which was irradiated for 4-reactor cycles in the Kori-1 NPP has been carried out while fuel rods selected from the assembly have been subjected to hot cell examination. In addition, several types of fastening devices for the dummy top nozzle of the fuel assembly have been fabricated and its reassembling forces tested to collect the design data for the reassembling device of the dismantled spent PWR fuel assembly. It is revealed that there is no any noticeable abnormality in the integrity of the fuel assembly under investigation. Fission gas releases seem to be 25-30cc which are about three times as much as those of 3-reactor cycle burnup fuel rods. The oxide layer thickness is about 30μm which is slightly thicker than that of the latter. Neverthelss, it is found that there is no detectable abnormalities in their integrity. Preliminary test results of fastening devices show that an internal expanding type one is excellent. (Author).

3062 (KAERI/TR–223/91) **Study on the quantitative rod internal pressure design criterion.** Kim, Kyu Tae (Korea Atomic Energy Research Inst., Daeduk (Korea, Republic of)); Han, Hee Tak; Kim, Oh Hwan; Chang, Young Ki. Korea Atomic Energy Research Inst., Daeduk (Korea, Republic of). Nov 1991. 54p. Order Number DE93607671. Source: OSTI; NTIS (US Sales Only); INIS.

The current rod internal pressure criterion permits fuel rods to operate with internal pressures in excess of system pressure only if internal over-pressure does not cause the diametral gap enlargement. In this study, the generic allowable internal gas pressures not violating this criterion are estimated as a function of a rod power. The results show that the generic allowable internal gas pressure decreases linearly with an increase of a rod power. Application of the generic allowable internal gas pressure for the rod internal pressure design criterion will result in the simplification of the current design procedure for checking the diametral gap enlargement caused by internal overpressure because according to the current design procedure the cladding creepout rate should be compared with the fuel swelling rate at each axial node at each time step whenever internal pressure exceeds system pressure. (Author).

3063 (KAERI/TR–225/91) **Determination of allowable ramp power levels to maintain the mechanical integrity for 14x14, 16x16 and 17x17 KOFAs.** Lee, Chan Bok (Korea Atomic Energy Research Inst., Daeduk (Korea, Republic of)); Kim, Ki Hang; Kim, Kyu Tae. Korea Atomic Energy Research Inst., Daeduk (Korea, Republic of). Nov 1991. 43p. Order Number DE93607672. Source: OSTI; NTIS (US Sales Only); INIS.

Transient behavior of the fuel rods with various rod power histories for 17x17 KOFA fuels has been calculated and evaluated, and sensitivity analyses of the key parameters such as rod power history before ramp, fast neutron flux and cycle length have also been performed. Results show that cladding strain is more limiting in determining the allowable ramp power level than fuel centerline temperature, and neutron flux has greatest influence on fuel transient behavior among rod power history before ramp, fast neutron flux and cycle length. Based upon the above results, allowable ramp power levels versus burnup for 14x14, 16x16 and 17x17 KOFA fuels were determined for the rods with different initial power levels of F_{xy} = 0.6, 0.8, 1.0 and 1.2, which shows that the rod with lower initial power level gives lower allowable ramp power level. It can be said, therefore, that if the ramp power level of the rod at certain initial power level and burnup is less than the corresponding allowable ramp power level, the transient behavior of the rod satisfy the fuel rod design criteria. (Author).

3064 (KAERI/TR–239/92) **Nuclear design report for Kori nuclear power plant Unit 1 Cycle 12.** Moon, Bok Ja (Korea Atomic Energy Research Inst., Daeduk (Korea, Republic of)); Cho, Byeong Ho; Lee, Chung Chan; Zee, Sung Kyun; Park, Chan Oh. Korea Atomic Energy Research Inst., Daeduk (Korea, Republic of). Jan 1992. 123p. Order Number DE93607673. Source: OSTI; NTIS (US Sales Only); INIS.

This report presents nuclear design calculations for Cycle 12 of Kori Unit 1. Information is given on fuel loading, power density distribution, reactivity coefficients, control rod worths and operational limits. In addition, the report contains all necessary data for the startup tests including predicted values for the comparison with the measured data. The reload consists of 48 KOFA's enriched by nominally 3.50 w/o U235. Among the KOFA's, 16 fuel assemblies contain gadolinia rods. The fuel assemblies in the core are arranged in a low leakage loading pattern. The cycle length of Cycle 12 amounts to 384 EFPD corresponding to a cycle burnup of 14480 MWD/MTU. (Author).

3065 (KAERI/TR–240/91) **Process improvement of reconversion facilities.** Park, Jin Ho (Korea Atomic Energy Research Inst., Daeduk (Korea, Republic of)); Chang, In Soon; Park, Jang Jin. Korea Atomic Energy Research Inst., Daeduk (Korea, Republic of). Jan 1992. 130p. (In Korean). (KNFC/TR–001/92.). Order Number DE93607674. Source: OSTI; NTIS (US Sales Only); INIS.

This project is for the development of recovery and reusing process of ammonium carbonate (AC) which is generated as a waste liquid from the reconversion facilities to reduce the manufacturing cost and the quantity of the waste liquid, and also for the development of the continuous fluidized bed reaction process to promote the economics and safeties of the calcination and reduction process. In this first year report it was possible to install the small scale equipment of 0.5kg-AUC per batch and to manufacture AUC particles at the ratio of one to one of AC and gas, but the more improvement of the particle agglomeration and particle size distribution is still required. We selected circulating fluidized bed as continuous reaction system and nonmechanical device instead of mechanical type as a UO_2 powder recycle system in view of the experimental results of the flowability of fine UO_2 powder and examined the system structure and each equipment design basis of the cold bed to get the referential design data for hot bed. (Author).

3066 (KAERI/TR–245/91) **Annual report of heavy water reactor fuel division.** Jeon, Poong Ill (Korea Atomic Energy Research Inst., Daeduk (Korea, Republic of)). Korea Atomic Energy Research Inst., Daeduk (Korea, Republic of). Jan 1992. 187p. (In Korean). Order Number DE93607675. Source: OSTI; NTIS (US Sales Only); INIS.

The Wolsung-type nuclear fuel localization project carried out since 1981 finally reached to a full-fledged phase in 1987. We successfully produced and timely delivered a yearly demand of nuclear fuel for Wolsung unit 1. In this report we studied and summarized

nuclear fuel contract and project control, fuel production and process control. Also, an economic analyses and future prospects for Wolsung-type nuclear fuel were carried out. (Author).

2204 Control Systems

Refer also to citation(s) 3166, 3168, 3169, 3300, 3308, 3331, 3332, 3373, 3382, 3388, 4799

3067 (CONF-900804–35) **Neural networks for sensor validation and plant monitoring.** Upadhyaya, B.R.; Eryurek, E.; Mathai, G. Tennessee Univ., Knoxville, TN (United States). [1990]. 10p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG07-88ER12824. From International topical meeting on fast reactor safety; Snowbird, UT (United States); 12-16 Aug 1990. Order Number DE93002127. Source: OSTI; NTIS; INIS; GPO Dep.

Sensor and process monitoring in power plants require the estimation of one or more process variables. Neural network paradigms are suitable for establishing general nonlinear relationships among a set of plant variables. Multiple-input multiple-output autoassociative networks can follow changes in plant-wide behavior. The backpropagation algorithm has been applied for training feedforward networks. A new and enhanced algorithm for training neural networks (BPN) has been developed and implemented in a VAX workstation. Operational data from the Experimental Breeder Reactor-II (EBR-II) have been used to study the performance of BPN. Several results of application to the EBR-II are presented.

3068 (CONF-9111215–1) **Fuzzy logic – artificial neural networks integration for transient identification.** Ikonomopoulos, A. (Tennessee Univ., Knoxville, TN (United States). Dept. of Nuclear Engineering); Tsoukalas, L.H.; Uhrig, R.E. Tennessee Univ., Knoxville, TN (United States). Dept. of Nuclear Engineering. [1991]. 7p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG07-88ER12824. From ANNIE '91: artificial neural networks in engineering conference; St. Louis, MO (United States); 10-13 Nov 1991. Order Number DE93002232. Source: OSTI; NTIS; GPO Dep.

A methodology is presented that integrates pretrained artificial neural networks (ANNs) with rule-based fuzzy logic systems, for the purpose of distinguishing different transients in a Nuclear Power Plant (NPP). In general this approach appears to provide timely, concise and task specific information about the status of a system under consideration. The pretrained neural network typifies different transient scenarios and derives membership functions which independently represent individual transients. The overall system successfully performs transient identification, in a time span faster or at least comparable to that of transient development. In order to examine the proposed methodology simulated accidents are used. The results obtained demonstrate the excellent noise tolerance of ANNs and suggest a new approach for transient identification.

3069 (CONF-9210191–1) **Coarse-grained simulation of a real-time process control network under peak load.** George, A.D. (Florida Agricultural and Mechanical Univ., Tallahassee, FL (United States)); Clapp, N.E. Jr. Oak Ridge National Lab., TN (United States). [1992]. 11p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. From Southeastern simulation conference; Pensacola, FL (United States); 22-23 Oct 1992. Order Number DE93001639. Source: OSTI; NTIS; INIS; GPO Dep.

This paper presents a simulation study on the real-time process control network proposed for the new ANS reactor system at ORNL. A background discussion is provided on networks, modeling, and simulation, followed by an overview of the ANS process control network, its three peak-load models, and the results of a series of coarse-grained simulation studies carried out on these models using implementations of 802.3, 802.4, and 802.5 standard local area networks.

3070 (CONF-9210193–1) **Distributed expert systems for nuclear reactor control.** Otaduy, P.J. Oak Ridge National Lab., TN (United States). [1992]. 10p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. From 5. international symposium on knowledge engineering; Seville (Spain); 5-9 Oct 1992. Order Number DE93001708. Source: OSTI; NTIS; INIS; GPO Dep.

A network of distributed expert systems is the heart of a prototype supervisory control architecture developed at the Oak Ridge National Laboratory (ORNL) for an advanced multimodular reactor. Eight expert systems encode knowledge on signal acquisition, diagnostics, safeguards, and control strategies in a hybrid rule-based, multiprocessing and object-oriented distributed computing environment. An interactive simulation of a power block consisting of three reactors and one turbine provides a realistic, testbed for performance analysis of the integrated control system in real-time. Implementation details and representative reactor transients are discussed.

3071 (HW–7-3212) **Effect of stainless steel thimbles on pile reactivity.** Marshall, L.W. Hanford Works, Richland, WA (United States). 14 Dec 1945. 3p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE93002058. Source: OSTI; NTIS (US Sales Only); GPO Dep.

Failure of a vertical safety rod thimble at 105-B has led to consideration of a stainless steel (SS) thimble as replacement. 1/16 in. SS would result in 4% loss in control power of that safety rod. If all thimbles were replaced by 1/16 in. SS, there would be a reactivity loss of 790 ih.

3072 (HW–7-4558) **Production test-105-55-P – Reactivity of the B Pile under shutdown conditions: Interim report.** Menegus, R.L. Hanford Works, Richland, WA (United States). 26 Jul 1946. 1p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE93002060. Source: OSTI; NTIS (US Sales Only); GPO Dep.

At the shutdown of the B Pile, 269 active tubes were discharged and ten poison columns were charged. As a result, the pile was let considerably below critical. The present test described in this report was set up to develop methods of detecting possible changes in reactivity by periodic measurements of neutron flux in the shutdown pile. The irradiation of indium foils in an empty process tube was found to provide a satisfactory method of monitoring the shutdown pile, and was sensitive than the proportional counter with was also tried. The accuracy with which the subcritical condition can be determined is roughly 20%. The uncertainty is due mostly to the irregular arrangement of metal and poison in the unit and the resulting difficulty in representing the neutron flux mathematically.

3073 (HW–25431) **Project C-431-B – Ball 3-X safety system – 105-C.** Reed, E.L. Hanford Works, Richland, WA (United States). 25 Aug 1952. 4p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE93002075. Source: OSTI; NTIS (US Sales Only); GPO Dep.

The following is recommended: Initial installation of 39 hoppers of mixed boron steel and ordinary steel balls (80% B steel balls, 20% ordinary steel balls). (The remaining 6 hoppers are to be filled with removable step plugs). Procurement of sufficient balls for possible later installation of 80-20 mixed balls in place of step plugs.

3074 (HW–26083) **C pile slug rupture detection system.** Paul, R.S. Hanford Works, Richland, WA (United States). 5 Nov 1952. 16p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE93002148. Source: OSTI; NTIS (US Sales Only); GPO Dep.

This memorandum discusses experimental determination which was made of the sensitivity and operational characteristics of the modified effluent water beta activity monitor system which is to be utilized at C pile for slug rupture detection. The optimum operating conditions for this system were also determined. A comparison of the performance of the C pile system with that of the existing Hanford type beta system was made to establish the degree of improvement realized through system redesign; this information being of assistance to the Pile Physics slug rupture detector development program. This report discusses the performance of both beta sensitive systems and the parameters upon which improved performance depends. A two ionization-chamber mockup of the C pile system was installed in the near effluent water sample room at H pile and utilized in these studies.

3075 (HW–76327) **Operating limits – Hanford Production Reactors.** General Electric Co., Richland, WA (United States). Hanford Atomic Products Operation. 5 Nov 1963. 16p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE93002082. Source: OSTI; NTIS (US Sales Only); GPO Dep.

This document provides Operating Limits which shall be applicable to the eight production reactor facilities, designated B, C, D, DR, F, H, KE and KW (hereinafter referred to as the Hanford Production Reactors) located at the Hanford site.

3076 (INIS-BR–2942, pp. 26-27) **Sub optimum determination of the homogenization factors in simulating the unitary distribution of azimuthal neutron flux in the annular control region.** Jachic, J. (Instituto de Engenharia Nuclear (IEN), Rio de Janeiro, RJ (Brazil). Div. de Fisica de Reatores). Instituto de Engenharia Nuclear (IEN), Rio de Janeiro, RJ (Brazil). Dept. de Reatores. 1989. 147p. (In Portuguese). (CONF-880440–: 2. Brazilian meeting on nuclear energy, Rio de Janeiro (Brazil), 23-26 Apr 1988). In *Triennial technical report - 1986, 1987, 1988 - Instituto de Engenharia Nuclear (IEN) -Dept. of Reactors (DERE).* Order Number DE93605069. Source: OSTI; NTIS (US Sales Only); INIS.

Published in full form as CT-DIFIR 14/87.

Published in summary form only. FAST REACTORS/ homogenization methods; FAST REACTORS/simulation; C CODES; CALIBRATION; CONTROL ELEMENTS; EXPERIMENTAL REACTORS; SIMULATION; MESH GENERATION; NEUTRON FLUX; ONE-DIMENSIONAL CALCULATIONS; OPTIMIZATION; SLABS; SPATIAL DISTRIBUTION

3077 (Juel–2573) **Modelling of neutron absorbers in high temperature reactors by combined transport-diffusion methods.** Fen, V. (Obninsk Inst. of Nuclear Power Engineering (USSR)); Lebedev, M.; Sarytchev, V.; Scherer, W. Forschungszentrum Juelich GmbH (Germany). Inst. fuer Sicherheitsforschung und Reaktortechnik. Jan 1992. 46p. Order Number DE93728949. Source: OSTI; NTIS (US Sales Only); INIS.

Today, the neutron-physical description of strong neutron absorbing materials for control and shut-down of nuclear power plants is performed using combined transport and diffusion methods. Two of these approaches are described and compared in this paper. The method of equivalent cross-sections has been developed at the KFA-Juelich Institute for Safety Research and Reactor Technology (ISR) and was widely used for all german HTR reactor concepts. The Obninsk Institute for Nuclear Power Engineering (OINPE) in UdSSR has worked out the response-matrix method for rodded regions. Both, equivalent cross-sections and response-matrix are results of transport calculations. They are subsequently used in multidimensional diffusion type reactor codes for the representation of absorber regions. The analysis of typical examples related to the modular pebble-bed HTR showed a good agreement of the results of both methods relative to each other and relative to pure transport calculations such as S-N and Monte-Carlo. (orig.).

3078 (KAERI/TR–237/91) **Control system setpoint study for westinghouse plant.** Lee, Chong Chul (Korea Atomic Energy Research Inst., Daeduk (Korea, Republic of)); Yoon, Han Young; Park, Jin Ho; Um, Kil Sup; Kim, Hee Cheol; Lee, Chong Chul. Korea Atomic Energy Research Inst., Daeduk (Korea, Republic of). Dec 1991. 60p. (In Korean). Order Number DE93607684. Source: OSTI; NTIS (US Sales Only); INIS.

Using the modified NLOOP 8810 PC version, NLOOP Setpoint version, Setpoint study was performed for Rod Control System and Steam Dump System of Kori Nuclear Power Plant Unit 3,4. 95 5, 50 5 Step Load Rejection and Turbine Trip Transients were analyzed for various steam Dump System Setpoints. The results show that the setpoints used in the licensing calculations are appropriate. (Author).

3079 (LUTFD2-TFRT–5439-1-127-1991) **Identification of process dynamics. Stability monitoring in BWR type reactors.** Abrahamsson, P.; Hallgren, P. Lund Univ. (Sweden). Dept. of Automatic Control. Jun 1991. 124p. (In Swedish). Order Number DE93607685. Source: OSTI; NTIS; INIS.

Examination paper.

Identification of process dynamics is used for stability monitoring in nuclear reactors (Boiling Water Reactor). This report treats the problem of estimating a damping factor and a resonance frequency from the neutron flux as measured in the reactor. A new parametric online method for identification is derived and presented, and is shown to meet the requirements of stability monitoring. The technique for estimating the process parameters is based on a recursive lattice filter algorithm. The problem of time varying parameters and offset, as well as offline experiments and signal processing are treated. All parts are implemented in a realtime program, using the language C. In comparison with earlier identifications, the new way of estimating the damping factor is shown to work well. Estimates of both the damping factor and the resonance frequency show a stable and reliable behavior. Future development and improvements are also indicated. (au).

3080 (ORNL/M–2259) **An investigation of scramming the outer shutdown rods of the ANS with no reversal of flow in the manifold inlet lines.** Morsk, K. (Royal Inst. of Tech., Stockholm (Sweden)). Oak Ridge National Lab., TN (United States). Oct 1992. 21p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. Order Number DE93002858. Source: OSTI; NTIS; INIS; GPO Dep.

This report provides calculations and calculation checks on the outer shutdown system, consisting of eight shutdown rods located on the outside of the core. The function of the system is to scram the reactor, or to break the chain reaction of the fission process. The shutdown rods are clad with a neutron-absorbing material (i.e., hafnium) to achieve scram. During normal operation, the outer shutdown rods (Fig. 1) are in a nonscram, withdrawn position. This means that they are not close enough to the core to absorb a significant number of the neutrons that cause the fission process. In the case of a malfunction or an emergency, the outer control rods are moved to a position near the core. The outer shutdown system is operated with the use of springs and hydraulics. During normal operation, a constant flow of heavy water is circulated through the reflector vessel. A part of this flow provides a pressure high enough to keep the rods in their withdrawn or upper position, a nonscram status. If any signs of abnormal operation occur, the valves in the hydraulic system cut off the flow, and the springs push the rods into the scram position, stopping the chain reaction. Once the flow is restarted, the rods can be withdrawn to the nonscram position. Calculations of the mass of the outer control rod, the scram spring data, and the hydraulic pressure to hold the rods in the withdrawn position have been checked. In the case of a malfunction of the flow/pressure relief valves, a calculation was needed to show that the scram time would not exceed the time allowed. The scram time has been determined based on different values of the rod insertion length and the outside radius of the annulus was calculated. The effective force pushing the rod into the scram position, the rate of acceleration, and the actual scram time was then determined.

3081 (SAND–92-1744C) **Prompt critical control of the ACRR using a linear quadratic regulator design.** Gilkey, J.C. Sandia National Labs., Albuquerque, NM (United States). [1992]. 5p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-76DP00789. (CONF-930103–8: 10. symposium on space nuclear power and propulsion, Albuquerque, NM (United States), 10-14 Jan 1993). Order Number DE92040271. Source: OSTI; NTIS; INIS; GPO Dep.

This paper describes the application of linear control design techniques to the problem of nuclear reactor control. The control algorithm consists of generating a nominal trajectory within the control authority of the reactor rod drives, and then following this trajectory with a gain scheduled linear quadratic regulator (LQR). A controller based on this algorithm has generated power pulses up to 100 MW on Sandia's Annular Core Research Reactor (ACRR). Prompt critical control at $1.02 net reactivity and controlled start up rates over 350 DPM have also been demonstrated using tills controller.

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Refer also to citation(s) 2660, 2662, 2663, 2670, 3028, 3152, 3171, 3187, 3310, 3366, 3437, 3440, 3492, 4238, 4370, 4371

3082 (CONF-9005435–1) **ALARA practices to minimize occupational radiation exposure from contamination at commercial nuclear power plants.** Reyes-Jimenez, J. (Tennessee Univ., Knoxville, TN (United States). Dept. of Nuclear Engineering); Tsoukalas, L. Tennessee Univ., Knoxville, TN (United States). Dept. of Nuclear Engineering. [1990]. 3p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG07-88ER12824. From 7. annual meeting of the Southeast Regional Health Physics Society chapters; Charleston, SC (United States); 3-5 May 1990. Order Number DE93002123. Source: OSTI; NTIS; INIS; GPO Dep.

Extended abstract.

Short communication. NUCLEAR POWER PLANTS/occupational exposure; REACTOR SAFETY; CONTAMINATION; ARTIFICIAL INTELLIGENCE; RADIATION PROTECTION

3083 (CONF-9005435–2) **A rule-based methodology for monitoring airborne radioactivity in nuclear power plants.** Tsoukalas, L. (Tennessee Univ., Knoxville, TN (United States). Dept. of Nuclear Engineering); Reyes-Jimenez, J.; Boshers, J.A. Tennessee Univ., Knoxville, TN (United States). Dept. of Nuclear Engineering. [1990]. 3p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG07-88ER12824. From 7. annual meeting of the Southeast Regional Health Physics Society chapters; Charleston, SC (United States); 3-5 May 1990. Order Number DE93002122. Source: OSTI; NTIS; INIS; GPO Dep.

Extended abstract.

Short communication. NUCLEAR POWER PLANTS/occupational exposure; RADIOACTIVE AEROSOLS/monitoring; RADIATION PROTECTION; ARTIFICIAL INTELLIGENCE; MONITORING

3084 (DOE/EIS–0144D-Vol.1) **Draft environmental impact statement for the siting, construction, and operation of New Production Reactor capacity: Volume 1, Summary.** USDOE Office of New Production Reactors, Washington, DC (United States). Apr 1991. 45p. Sponsored by USDOE, Washington, DC (United States). Order Number DE93004081. Source: OSTI; NTIS (US Sales Only); GPO Dep.

This Environmental Impact Statement (EIS) assesses the potential environmental impacts, both on a broad programmatic level and on a project-specific level, concerning a proposed action to provide new tritium production capacity to meet the nation's nuclear defense requirements well into the 21st century. A capacity equivalent to that of about a 3,000-megawatt (thermal) heavy-water reactor was assumed as a reference basis for analysis in this EIS; this is the approximate capacity of the existing production reactors at DOE's Savannah River Site near Aiken, South Carolina. The EIS programmatic alternatives address Departmental decisions to be made on whether to build new production facilities, whether to build one or more complexes, what size production capacity to provide, and when to provide this capacity. Project-specific impacts for siting, constructing, and operating new production reactor capacity are assessed for three alternative sites: the Hanford Site near Richland, Washington; the Idaho National Engineering Laboratory near Idaho Falls, Idaho; and the Savannah River Site. For each site, the impacts of three reactor technologies (and supporting facilities) are assessed: a heavy-water reactor, a light-water reactor, and a modular high-temperature gas-cooled reactor. Impacts of the no-action alternative also are assessed. The EIS evaluates impacts related to air quality; noise levels; surface water, groundwater, and wetlands; land use; recreation; visual environment; biotic resources; historical, archaeological, and cultural resources; socioeconomics; transportation; waste management; and human health and safety. The EIS describes in detail the potential radioactive releases from new production reactors and support facilities and assesses the potential doses to workers and the general public.

3085 (DOE/EIS–0144D-Vol.2) **Draft environmental impact statement for the siting, construction, and operation of New Production Reactor capacity: Volume 2, Sections 1-6.** USDOE Office of New Production Reactors, Washington, DC (United States). Apr 1991. 656p. Sponsored by USDOE, Washington, DC (United States). Order Number DE93004082. Source: OSTI; NTIS (US Sales Only); GPO Dep.

This (EIS) assesses the potential environmental impacts, both on a broad programmatic level and on a project-specific level, concerning a proposed action to provide new tritium production capacity to meet the nation's nuclear defense requirements well into the 21st century. A capacity equivalent to that of about a 3,000-megawatt (thermal) heavy-water reactor was assumed as a reference basis for analysis in this EIS; this is the approximate capacity of the existing production reactors at DOE's Savannah River Site. The EIS programmatic alternatives address Departmental decisions to be made on whether to build new production facilities, whether to build one or more complexes, what size production capacity to provide, and when to provide this capacity. Project-specific impacts for siting, constructing, and operating new production reactor capacity are assessed for three alternative sites: the Hanford Site near Richland, Washington; the Idaho National Engineering Laboratory near Idaho Falls, Idaho; and the Savannah River Site. For each site, the impacts of three reactor technologies (and supporting facilities) are assessed: a heavy-water reactor, a light-water reactor, and a modular high-temperature gas-cooled reactor. Impacts of the no-action alternative also are assessed. The EIS evaluates impacts related to air quality; noise levels; surface water, groundwater, and wetlands; land use; recreation; visual environment; biotic resources; historical, archaeological, and cultural resources; socioeconomics; transportation; waste management; and human health and safety. The EIS describes in detail the potential radioactive releases from new production reactors and support facilities and assesses the potential doses to workers and the general public. This volume contains the analysis of programmatic alternatives, project alternatives, affected environment of alternative sites, environmental consequences, and environmental regulations and permit requirements.

3086 (DOE/EIS–0144D-Vol.3) **Draft environmental impact statement for the siting, construction, and operation of New Production Reactor capacity: Volume 3, Sections 7-12, Appendices A-C.** USDOE Office of New Production Reactors, Washington, DC (United States). Apr 1991. 302p. Sponsored by USDOE, Washington, DC (United States). Order Number DE93004083. Source: OSTI; NTIS (US Sales Only); GPO Dep.

This Environmental Impact Statement (EIS) assesses the potential environmental impacts, both on a broad programmatic level and on a project-specific level, concerning a proposed action to provide new tritium production capacity to meet the nation's nuclear defense requirements well into the 21st century. A capacity equivalent to that of about a 3,000-megawatt (thermal) heavy-water reactor was assumed as a reference basis for analysis in this EIS; this is the approximate capacity of the existing production reactors at DOE's Savannah River Site near Aiken, South Carolina. The EIS programmatic alternatives address Departmental decisions to be made on whether to build new production facilities, whether to build one or more complexes, what size production capacity to provide, and when to provide this capacity. Project-specific impacts for siting, constructing, and operating new production reactor capacity are assessed for three alternative sites: the Hanford Site near Richland, Washington; the Idaho National Engineering Laboratory near Idaho Falls, Idaho; and the Savannah River Site. For each site, the impacts of three reactor technologies (and supporting facilities) are assessed: a heavy-water reactor, a light-water reactor, and a modular high-temperature gas-cooled reactor. Impacts of the no-action alternative also are assessed. The EIS evaluates impacts related to air quality; noise levels; surface water, groundwater, and wetlands; land use; recreation; visual environment; biotic resources; historical, archaeological, and cultural resources; socioeconomics; transportation; waste management; and human health and safety. The EIS describes in detail the potential radioactive releases from new production reactors and support facilities and assesses the potential doses to workers and the general public. This volume contains references; a list of preparers and recipients; acronyms, abbreviations, and units of measure; a glossary; an index and three appendices.

3087 (DOE/EIS–0144D-Vol.4) **Drart environmental impact statement siting, construction, and operation of New Production Reactor capacity: Volume 4, Appendices D-R.** USDOE Office of New Production Reactors, Washington, DC (United States). Apr 1991. 705p. Sponsored by USDOE, Washington, DC

(United States). Order Number DE93004080. Source: OSTI; NTIS (US Sales Only); GPO Dep.

This Environmental Impact Statement (EIS) assesses the potential environmental impacts, both on a broad programmatic level and on a project-specific level, concerning a proposed action to provide new tritium production capacity to meet the nation's nuclear defense requirements well into the 21st century. A capacity equivalent to that of about a 3,000-megawatt (thermal) heavy-water reactor was assumed as a reference basis for analysis in this EIS; this is the approximate capacity of the existing production reactors at DOE's Savannah River Site near Aiken, South Carolina. The EIS programmatic alternatives address Departmental decisions to be made on whether to build new production facilities, whether to build one or more complexes, what size production capacity to provide, and when to provide this capacity. Project-specific impacts for siting, constructing, and operating new production reactor capacity are assessed for three alternative sites: the Hanford Site near Richland, Washington; the Idaho National Engineering Laboratory near Idaho Falls, Idaho; and the Savannah River Site. For each site, the impacts of three reactor technologies (and supporting facilities) are assessed: a heavy-water reactor, a light-water reactor, and a modular high-temperature gas-cooled reactor. Impacts of the no-action alternative also are assessed. The EIS evaluates impacts related to air quality; noise levels; surface water, groundwater, and wetlands; land use; recreation; visual environment; biotic resources; historical, archaeological, and cultural resources; socioeconomics; transportation; waste management; and human health and safety. The EIS describes in detail the potential radioactive releases from new production reactors and support facilities and assesses the potential doses to workers and the general public. This volume contains 15 appendices.

3088 (DUN–7211) **Reactor effluent water analytical data, January–June 1970.** Larrick, A.P. Douglas United Nuclear, Inc., Richland, WA (United States). 17 Aug 1970. 12p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE93000320. Source: OSTI; NTIS (US Sales Only); GPO Dep.

This report contains all of the analytical results from cooling water effluent samples from KE and KW Reactors for the first six months of 1970. The results are reported in pCi/ml ($p=10^{-12}$) corrected to the time of sampling.

3089 (HW–61206) **Effluent system modifications – 100-B/C.** Corley, J.P. General Electric Co., Richland, WA (United States). Hanford Atomic Products Operation. 7 Oct 1959. 15p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE93002081. Source: OSTI; NTIS (US Sales Only); GPO Dep.

The 107-B retention basin was constructed in 1943–44 as part of the original reactor installation. Thermal stressing has caused extensive cracking of the concrete walls and leaking at cracks and joints, requiring repeated maintenance including a major repair program in 1952–53. Although a major repair or replacement program will eventually be necessary, existing basin leakage does not require immediate action, other than periodic control effort, with one exception. Effluent from 107-B leakage is flowing into the 181-B river pumphouse forebay, measurably increasing the temperature of the raw water and raising the question of continued stability of the building foundation. A basic inadequacy also exists in the inability to dispose of undesirable effluents other than to the river. The unique situation of B Reactor adjacent to the C Reactor effluent system permits consideration of improving the effluent disposal situation in this one area with minimum capital investment. The purpose of this report is to provide the scope for a project proposal for interim effluent system modifications in 100-B Area only. This will avoid future production losses and improve effluent disposal capability during resolution of a more permanent solution to the overall problem of effluent routing and treatment.

3090 (IAEA-INES–92/01) **INES: The International Nuclear Event Scale user's manual: Revised and extended edition 1992.** International Atomic Energy Agency, Vienna (Austria); Nuclear Energy Agency, 75 - Paris (France). Sep 1992. 90p. Order Number DE93607695. Source: OSTI; NTIS (US Sales Only); INIS.

The revised and extended addition of the International Nuclear Event Scale is presented. The manual is comprised of four parts. Part 1 contains a summary of the basis of the scale and of the procedure to be used for rating events. Part 2 contains the detailed guidance required to rate events in terms of off-site and on-site impact. These two parts are applicable to all nuclear facilities. Parts 3 and 4 contain the detailed guidance required to rate events in terms of defence in depth for reactors and other facilities, respectively. 5 figs, 2 tabs.

3091 (IAEA-TECDOC–643(v.2), pp. 155-178) **Radiological consequence analysis.** Woodruff, W.L. (Argonne National Lab., Argonne, IL (United States). RERTR Program); Warinner, D.K.; Matos, J.E. International Atomic Energy Agency, Vienna (Austria). Apr 1992. In *Research reactor core conversion guidebook. V.2: Analysis (Appendices A-F).* 386p. Order Number DE93607344. Source: OSTI; NTIS (US Sales Only); INIS.

A model for estimating the radiological consequences from a hypothetical accident in HEU and LEU fueled research and test reactors is presented. Simple hand calculations based on fission product yield table inventories and non-site specific dispersion data may be adequate in many cases. However, more detailed inventories and site specific data on meteorological conditions and release rates and heights can result in substantial reductions in dose estimates. LEU fuel gives essentially the same doses as HEU fuel. The plutonium buildup in the LEU fuel does not significantly increase the radiological consequences. The dose to the thyroid is the limiting dose. (author). 12 refs, 3 figs, 10 tabs.

3092 (IAEA-TECDOC–643(v.2), pp. 179-183) **Radiological consequence analysis.** Baglin, C. (GEC Energy Systems Ltd., Leicester (United Kingdom)); Allen, F.R. International Atomic Energy Agency, Vienna (Austria). Apr 1992. In *Research reactor core conversion guidebook. V.2: Analysis (Appendices A-F).* 386p. Order Number DE93607344. Source: OSTI; NTIS (US Sales Only); INIS.

An overview of the methods used by the Safety and Reliability Directorate of the UKAEA for conducting a radiological consequence analysis is described. For the assessment of accidental releases of radioactive material to the atmosphere, it would be normal in the UK to use the TIRION or WEERIE suites of computer codes. A general description of the models used in the TIRION code (Gaussian-plume, constant weather) is provided along with a simpler and quicker method of obtaining public doses by using prepared solutions to the diffusion equation plus dose conversion factors. (author). 9 refs, 1 fig.

3093 (IAEA-TECDOC–643(v.2), pp. 185-200) **Estimation of radiological doses from research reactor accidents.** Anoussis, J.N. (National Research Centre for the Physical Sciences Democritos, Athens (Greece)); Chrysochoides, N.G. International Atomic Energy Agency, Vienna (Austria). Apr 1992. In *Research reactor core conversion guidebook. V.2: Analysis (Appendices A-F).* 386p. Order Number DE93607344. Source: OSTI; NTIS (US Sales Only); INIS.

A model for calculating radiological consequences for research reactor accidents is described. The model covers all steps of the chain, Source term → Air concentration of radioactivity → Absorbed dose and is purposely simple for use when additional computer codes are not available. All approximations used lie on the conservation side. Minimum necessary data required for the relevant calculations are also given. The Gaussian dispersion model is used for the air concentration of radioactivity and its conversion to dose is made by using the appropriate conversion factors for specific points of impact, radionuclides and exposure time intervals of interest. The described model and methodology was already applied in the SAR example (Appendix E-6 of the present guidebook) with results in good agreement with the ones derived in similar cases. (author). 17 refs.

3094 (IAEA-TECDOC–643(v.2), pp. 201-209) **Radiological consequence analysis for a high power Canadian research reactor.** Axford, D.J. (Atomic Energy of Canada Ltd., Chalk River, ON (Canada). Chalk River Nuclear Labs.). International Atomic Energy

Agency, Vienna (Austria). Apr 1992. In *Research reactor core conversion guidebook. V.2: Analysis (Appendices A-F).* 386p. Order Number DE93607344. Source: OSTI; NTIS (US Sales Only); INIS.

Some of the factors to be considered in a radiological consequence analysis for a high power Canadian research reactor are described. Methods of determining the inventory of fission products and some of the factors affecting the fission product release are considered. Atmospheric dispersion factors are also described. Simple formulae and correction factors are given for calculating whole body external doses for gamma radiation from a cloud of noble gas fission products. (author). 16 refs, 3 figs, 1 tab.

3095 (IAEA-TECDOC–643(v.2), pp. 211-232) **Fundamental calculational model for the determination of the radiological effects, inside and outside a research reactor, after hypothetical accidents, with release of high amounts of fission products from the core.** International Atomic Energy Agency, Vienna (Austria); Internationale Atomreaktorbau GmbH (INTERATOM), Bergisch Gladbach (Germany). Apr 1992. In *Research reactor core conversion guidebook. V.2: Analysis (Appendices A-F).* 386p. Order Number DE93607344. Source: OSTI; NTIS (US Sales Only); INIS.

A fundamental calculational model is presented for determination of the radiological effects, inside and outside a research reactor, after hypothetical accidents, with release of high amounts of fission products from the core. Conservative calculation methods are used to solve the problem. The reference reactor for the model assumption is a pool type (light water) reactor. Models are presented for the following processes: source term, containment and activity enclosure, time dependent activity behaviour in the reactor building, radiation exposure in the reactor plant, and radiological exposure in the environment. (author). 6 tabs.

3096 (IAEA-TECDOC–643(v.2), pp. 233-247) **Radiological consequence analysis for UZrH fuel.** International Atomic Energy Agency, Vienna (Austria); General Atomics, San Diego, CA (United States). Apr 1992. In *Research reactor core conversion guidebook. V.2: Analysis (Appendices A-F).* 386p. Order Number DE93607344. Source: OSTI; NTIS (US Sales Only); INIS.

Methods and sample calcuiations are presented for a radiological consequence analysis for UZrH fuel failure in a TRIGA reactor. The analysis summarizes results for the fission product release due to failure of a single fuel-rod cladding in water and design basis fission product releases for failure of all fuel rods in a 16-rod cluster in air and in water. Fission product inventories and release fractions, building release and downwind doses are described and compared to design basis dose criteria. (author). 5 refs, 2 figs, 7 tabs.

3097 (INIS-BR–3026) **Strontium and calcium determination in sea fishes in neighborhood of Angra nuclear power plant.** Ferreira, L.M.J. Universidade do Estado, Rio de Janeiro, RJ (Brazil). Centro Biomedico. 1985 112p. (In Portuguese). Order Number DE93607333. Source: OSTI; NTIS (US Sales Only); INIS.

Strontium-90 is an important radionuclide present in the liquid effluents of the Angra Nuclear Power Plant, located in the coastline of Rio de Janeiro State. It has a long effective half-life, easy entry into food chain due to its chemical similarity to calcium and stays for a long time in solution. With the aim of calculating the concentration factor (CF) for ^{90} Sr and observed ratio (OR) in the most abundant local fish, it was determined the strontium and calcium content in the edible fraction of nine species and in sea water by atomic absorption spectrophotometry. (author).

3098 (KAERI/TR–236/91) **Development of the radiological consequences analysis model for the postulated accidents.** Um, Kil Sup (Korea Atomic Energy Research Inst., Daeduk (Korea, Republic of)); Kim, Jung Jin; Yoo, Hyung Kum; Yoon, Han Young; Lee, Chong Chul. Korea Atomic Energy Research Inst., Daeduk (Korea, Republic of). Dec 1991. 96p. (In Korean). Order Number DE93607340. Source: OSTI; NTIS (US Sales Only); INIS.

The objective of this report is to establish the radiological consequence analysis methodology for the postulated accidents which result in the radioactivity release to the ambient air. For this, reviewing were the methodology described in the Final Safety Analysis Report for the Korean Units and the guidelines for the radiological consequences analysis. Then, the established methodology was verified through evaluating the offsite doses of the Yonggwang 1 and 2 unit for the postulated accidents categorized by condition IV. It reveals that the sensitive parameters for the radiological consequences are the fraction of the damaged or melted fuel, the partition factor of the halogens in the steam generator, the removal capacity of the purification system and the radioactive decay characteristics. Also, it shows that the amount of radioactivity release are limited mainly by the design leakage rate of the U-tube and the containment. (Author).

2206 Research, Test, Training, Production, Irradiation, Materials Testing Reactors

Refer also to citation(s) 2658, 2659, 2660, 2661, 2662, 2663, 2664, 2665, 2666, 2667, 2668, 2669, 2670, 2679, 2702, 2703, 2704, 2705, 2706, 2707, 2708, 2709, 2710, 2711, 2712, 3025, 3032, 3071, 3072, 3073, 3074, 3075, 3080, 3081, 3088, 3089, 3091, 3093, 3094, 3095, 3096, 3300, 3301, 3304, 3305, 3306, 3307, 3308, 3309, 3310, 3311, 3397, 3398, 3399, 3404, 3410, 3445, 3446, 4370, 4643, 4765

3099 (CDTN-LABRE-NT–004/80) **Irradiation routine in the IPR-R1 Triga reactor.** Maretti Junior, F. Centro de Desenvolvimento da Tecnologia Nuclear (CDTN), Belo Horizonte, MG (Brazil). 1 Sep 1980. 35p. (In Portuguese). Order Number DE93607809. Source: OSTI; NTIS (US Sales Only); INIS.

Information about irradiations in the IPR-R1 TRIGA reactor and procedures necessary for radioisotope solicitation are presented All procedures necessary for asking irradiation in the reactor, shielding types, norms of terrestrial and aerial expeditions, payment conditions, and catalogue of disposable isotopes with their respective saturation activities are described. (M.C.K.).

3100 (CNEN-DR-GAN-NT–02/89) **Summary of IEA-R1 research a reactor licensing related to its power increase from 2 to 10 MW.** Comissao Nacional de Energia Nuclear (CNEN), Rio de Janeiro, RJ (Brazil). Dept. de Reatores. Apr 1989. 9p. (In Portuguese). Order Number DE93607810. Source: OSTI; NTIS (US Sales Only); INIS.

This work is a summary of IEA-R1 research reactor licensing related to its power increase from 2 to 10 MW. It reports also safety requirements, fuel elements, and reactor control modifications inherent to power increase. (A.C.A.S.).

3101 (CONF-920146–7) **Pressure vessel steel embrittlement monitoring by magnetic properties measurements.** Stubbins, J.F. (Illinois Univ., Urbana, IL (United States). Dept. of Nuclear Engineering); Shong, W-J.; Giacobbe, M.; Ougouag, A.M.; Williams, J.G. Illinois Univ., Urbana, IL (United States). Dept. of Nuclear Engineering. [1992]. 18p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG02-90ER13030. From ASTM international symposium on small specimen test techniques and their applications to nuclear reactor vessel thermal annealing and plant life extension; New Orleans, LA (United States); 29-31 Jan 1992. Order Number DE93002119. Source: OSTI; NTIS; GPO Dep.

The magnetic properties of specimens of one heat of A533B nuclear pressure vessel grade steel have been examined in the as-received condition and after neutron irradiation to various fluence levels up to 4×10^{18} cm^{-2} ($E > 0.1$ MeV) in the University of Illinois Advanced TRIGA reactor core at two temperatures, approximately 120 and 260°C. The effect of some heat treatments was also investigated. The magnetic properties were measured by an automated hysteresis curve tracing method using a miniature transformer which incorporated the specimens in its core. Changes in magnetic hysteresis energy loss were correlated with neutron fluence in the case of certain irradiated specimens, and with microhardness measurements in the case of heat treated specimens. At the higher irradiation temperatures, no significant changes in either the magnetic hysteresis properties or the microhardness were noted for the present fluences. The relationship between the observed magnetic properties response and irradiation-induced embrittlement is discussed.

3102 (DPSP–69-1172-Del.Ver.) **Enriched uranium fuel quality: Preliminary report.** Jacobsen, W.R. Du Pont de Nemours (E.I.) and Co., Aiken, SC (United States). Savannah River Lab. 18

Mar 1969. 14p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC09-89SR18035. (RTR–1070). Order Number DE93002408. Source: OSTI; NTIS (US Sales Only); GPO Dep.

Mark VI-J, B, and E fuel exhibit about the same rate of growth of exposed core, the final amount of exposed core depending on cycle length (exposure). Extremes show a factor of 2 or greater variations from the average within a given fuel type. Mark XII-A and Mark 14 fuel show more rapid rates of growth of exposed core than Mark VI. Amount of exposed core in Mark XII-A cycles also appears to increase more rapidly than Mark 14; more data is needed. Fuel cycles with less than 75,000 MWD final exposure show no clear increase in activity with exposure above scattered background values.

3103 (DPW–53-7-2) **Manufacturing Division, Process Section monthly report, February 1953.** Du Pont de Nemours (E.I.) and Co., Wilmington, DE (United States). Explosives Dept. 15 Mar 1953. 20p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC09-76SR00001. (SR/H–240). Order Number DE93001917. Source: OSTI; NTIS (US Sales Only); GPO Dep.

This report details activities of the Process Section of the Manufacturing Division during the month of February 1953.

3104 (DPW–53-7-5) **Process Section, Manufacturing Division monthly report, May 1953.** Du Pont de Nemours (E.I.) and Co., Wilmington, DE (United States). Explosives Dept. 15 Jun 1953. 22p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC09-76SR00001. (SR/H–243). Order Number DE93002370. Source: OSTI; NTIS (US Sales Only); GPO Dep.

This report details activities of the Process Section of the Manufacturing Division during the month of May 1953.

3105 (DPW–53-7-10) **Process Section, Manufacturing Division monthly report, October 1953.** Du Pont de Nemours (E.I.) and Co., Wilmington, DE (United States). Explosives Dept. 1953. 20p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC09-76SR00001. (SR/H–242). Order Number DE93002369. Source: OSTI; NTIS (US Sales Only); GPO Dep.

This report details activities of the Process Section of the Manufacturing Division during the month of October 1953.

3106 (DPW–53-7-11) **Process Section, Manufacturing Division monthly report, November 1953.** Du Pont de Nemours (E.I.) and Co., Wilmington, DE (United States). Explosives Dept. 15 Dec 1953. 20p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC09-76SR00001. (SR/H–241). Order Number DE93002368. Source: OSTI; NTIS (US Sales Only); GPO Dep.

This report details activities of the Process Section of the Manufacturing Division during the month of November 1953.

3107 (DPW–53-639) **Visit by F. N. Rhines of Carnegie Institute of Technology, March 19, 1953.** Huntoon, R.T. Du Pont de Nemours (E.I.) and Co., Wilmington, DE (United States). Explosives Dept. 24 Mar 1953. 2p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC09-76SR00001. (SR/H–251). Order Number DE93002717. Source: OSTI; NTIS (US Sales Only); GPO Dep.

R.N. Rhines of CIT visited Wilmington to discuss various metallurgical aspects of the NFED Program. Particular emphasis was placed on consultants for powder metallurgy, soldering of aluminum, and barrier layers for use in the bonding system.

3108 (DPW–53-650) **Hydrostatic testing and safety devices.** Du Pont de Nemours (E.I.) and Co., Wilmington, DE (United States). Explosives Dept. 7 Apr 1953. 4p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC09-76SR00001. (SR/H–252). Order Number DE93002718. Source: OSTI; NTIS (US Sales Only); GPO Dep.

Short communication. PRESSURE VESSELS/materials testing; RELIEF VALVES/materials testing; SAVANNAH RIVER PLANT; STATIC LOADS; HYDROSTATICS; HYDRAULICS; HEAT TRANSFER

3109 (DPW–53-654) **100 Area scope of work: Use of enriched slugs for tritium production.** Du Pont de Nemours (E.I.) and Co., Wilmington, DE (United States). Explosives Dept. 7 Apr 1953. 4p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC09-76SR00001. (SR/H–256). Order Number DE93002722. Source: OSTI; NTIS (US Sales Only); GPO Dep.

AED has been requested to prepare for increased tritium production over that previously planned by being in position to load enriched fuel slugs in "L" reactor by April, 1954. It is our intent to do this in a manner requiring the least modification of currently-designed components and facilities – designs to effect maximum economy and efficiency, as for example the use of long elements, will be deferred until some later date. This memorandum will confirm information given you verbally in a meeting with AED representatives on March 31, at which time you were asked to initiate design work to accomplish the above objective. The presently visualized loading system consist of three columns of enriched uranium-aluminum alloy slugs and one column of lithium-aluminum producer slugs loaded into a standard Q-tube assembly. It is necessary that the Li-Al producer slugs be discharged on a different schedule than the U-Al slugs – producer slugs will probably be discharged at three to six month intervals; fuel slugs will probably be discharged at nine to twelve month intervals.

3110 (DPW–53-656) **Discussion with National Research Corporation personnel, April 1, 1953.** Dunnington, B.W. Du Pont de Nemours (E.I.) and Co., Wilmington, DE (United States). Explosives Dept. 2 Apr 1953. 2p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC09-76SR00001. (SR/H–257). Order Number DE93002723. Source: OSTI; NTIS (US Sales Only); GPO Dep.

John H. Durant and Phillip Clough of National Research Corporation visited Wilmington on April 1. 1953. Persons contacted were F.M. Burns, J.C. Woodhouse, K.G. Jones, R.T. Huntoon, and B.W. Dunnington. The purpose of the visit was to complete a purchase order for coated uranium samples. These coatings would then serve as the bondlayers in uranium-aluminum flat plate fuel assemblies. It is hoped that this work may also provide leads for a satisfactory non-wrought sheath. Terms of an order were agreed to and the order was completed. This order is for $10,000, and is for a period of four months.

3111 (DPW–5385) **Building 777-M, Physics Assembly Laboratory, PDP component handling and storage.** Toops, E.C. Du Pont de Nemours (E.I.) and Co., Wilmington, DE (United States). Explosives Dept. 15 May 1952. 3p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC09-76SR00001. (SR/H–221). Order Number DE93001454. Source: OSTI; NTIS (US Sales Only); GPO Dep.

This memorandum provides a description of reactor component handling and storage requirements.

3112 (DPW–5477) **Project 8980: Savannah River Plant design contacts and approvals for the Atomic Energy Division.** Tinker, J.B. Du Pont de Nemours (E.I.) and Co., Wilmington, DE (United States). Explosives Dept. 26 May 1952. 3p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC09-76SR00001. (SR/H–232). Order Number DE93001909. Source: OSTI; NTIS (US Sales Only); GPO Dep.

This memorandum describes the formation of a Process Section within the Production Division. The Process Section was delegated direct responsibility for handling liaison with the Design Division, and for approving designs and drawings before final issue.

3113 (DPW–5489) **ANL slug failure decontamination program: Trip report.** Heston, W.M.; Bellas, H.W. Du Pont de Nemours (E.I.) and Co., Wilmington, DE (United States). Explosives Dept. 26 May 1952. 3p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC09-76SR00001. (SR/H–233). Order Number DE93001910. Source: OSTI; NTIS (US Sales Only); GPO Dep.

A trip was made to ANL to review the status of the slug failure decontamination program currently in progress. Plans for the continuation of the program were presented. It is hoped that a costly time-consuming chemical decontamination of the reactor will not be required following each slug failure. It seems reasonable to assume that operation of the reactor will be attempted as soon as the ruptured slug has been removed and the activity in the water has reached tolerable levels. Local areas temporarily contaminated by

the presence of selected uranium oxides might be decontaminated by the high moderator flow rate which would tend to solubilize and transport these solid oxide particles to the purification system.

3114 (DPW–5513) **Savannah River Plant Hand and Foot Counter.** Bowman, H.J. Du Pont de Nemours (E.I.) and Co., Wilmington, DE (United States). 29 May 1952. 3p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC09-76SR00001. (SR/H–235). Order Number DE93001912. Source: OSTI; NTIS (US Sales Only); GPO Dep.

This memorandum provides preliminary comments after original review of the prototype Hand and Foot Counter manufactured by Nuclear Instrument and Chemical Company.

3115 (DPW–5695) **Ideal rod powers, IBM table.** Neill, J.S. Du Pont de Nemours (E.I.) and Co., Wilmington, DE (United States). Explosives Dept. 7 Sep 1954. 225p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC09-76SR00001. (SR/H–202). Order Number DE93000663. Source: OSTI; NTIS (US Sales Only); GPO Dep.

This document provides a table which gives the kilowatt rating of the ideal fuel tube (slug surface temperature limiting) for a cosine flux distribution. The equations which were used are given in the Appendix. The solutions were obtained from the computing center of the International Business Machine Company, New York City, in March, 1951.

3116 (DPW–5801) **ANL slug failure decontamination studies: Trip report.** Heston, W.M. Du Pont de Nemours (E.I.) and Co., Wilmington, DE (United States). Explosives Dept. 9 Jul 1952. 6p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC09-76SR00001. (SR/H–207). Order Number DE93001234. Source: OSTI; NTIS (US Sales Only); GPO Dep.

This memorandum discusses a number of trips (June 12–13, 24–26, and July 1–2) which were made to ANL to follow up experimental work related to problems of reactor operating procedure during and after slug failure. This report is the third in a series and reports the results of work on the slug failure loop, laboratory studies of the solubility of UO_2 in high purity water, and chemical decontaminating agents.

3117 (DPW–6780) **Operation of process development pile.** Wende, C.W.J. Du Pont de Nemours (E.I.) and Co., Wilmington, DE (United States). Explosives Dept. 9 Dec 1952. 14p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC09-76SR00001. (SR/H–247). Order Number DE93002374. Source: OSTI; NTIS (US Sales Only); GPO Dep.

Operation of the Process Development Pile for several months in advance of the R Pile startup will help us to achieve and sustain full-power operation of the R Pile more quickly and certainly. In the absence of information from the PDP, it is estimated that the first complete cycle of the R Pile might require about a year. With such information, this time might be cut by two or three months. Experience at other sites has demonstrated the feasibility of using large quantities of heavy water for experimental purposes. The risk of loss or contamination is small. In view of the large potential gains and the small risk to the heavy water, it is recommended that the PDP be started up as far in advance of the R Pile as possible.

3118 (EGG-EAST–9803) **Developmental assessment of the multidimensional component in RELAP5 for Savannah River Site thermal hydraulic analysis.** Hanson, R.G.; Johnson, E.C. (eds.); Carlson, K.E.; Chou, C.Y.; Davis, C.B.; Martin, R.P.; Riemke, R.A.; Wagner, R.J. EG and G Idaho, Inc., Idaho Falls, ID (United States). Jul 1992. 204p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC07-76ID01570. Order Number DE93001942. Source: OSTI; NTIS; INIS; GPO Dep.

This report documents ten developmental assessment problems which were used to test the multidimensional component in RELAP5/MOD2.5, Version 3w. The problems chosen were a rigid body rotation problem, a pure radial symmetric flow problem, an r-θ symmetric flow problem, a fall problem, a rest problem, a basic one-dimensional flow test problem, a gravity wave problem, a tank draining problem, a flow through the center problem, and coverage analysis using PIXIE. The multidimensional code calculations are compared to analytical solutions and one-dimensional code calculations. The discussion section of each problem contains information relative to the code's ability to simulate these problems.

3119 (EGG-EAST–9878) **Theory and input requirements for the multidimensional component in RELAP5 for Savannah River Site thermal hydraulic analysis.** Hanson, R.G.; Johnson, E.C. (eds.); Carlson, K.E.; Riemke, R.A.; Wagner, R.J. EG and G Idaho, Inc., Idaho Falls, ID (United States). Jul 1992. 113p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC07-76ID01570. Order Number DE93001926. Source: OSTI; NTIS; INIS; GPO Dep.

This report documents the theory and input requirements for the multidimensional component in RELAP5/MOD2.5, Version 3w. The equations in Cartesian and cylindrical coordinates are presented as well as the shallow water terms. The implementation of these equations is then discussed. Finally, the constitutive models and input requirements are then described.

3120 (EGG-M–92072) **That was then and this is now: A case study of document control for the Advanced Test Reactor.** Collins, S.K.; Meltzer, F.L. EG and G Idaho, Inc., Idaho Falls, ID (United States). [1992]. 6p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC07-76ID01570. (CONF-920849–2: 16. annual Nuclear Information and Records Management Association symposium: shared information - golden gateway to progress, San Francisco, CA (United States), 30 Aug - 2 sep 1992). Order Number DE93001958. Source: OSTI; NTIS; GPO Dep.

Even as Department of Energy (DOE) budgets are being adjusted to reflect the changing international scene, DOE and its contractors are becoming more proactive in environment, safety, and health. This focus places stringent requirements on Configuration Management-Document Control. EG&G Idaho, Inc. (EG&G Idaho), a prime management and operations contractor for DOE at the Idaho National Engineering Laboratory (INEL), operates the Advanced Test Reactor (ATR) as a major continuing program. The ATR has been operating for 25 years, under successive contractors. The requirements and techniques originally developed and applied to configuration management-document control were, by today's standards, casual. To maximize the cost-effectiveness and accuracy of ATR Configuration Management-Document Control, a major effort was required. Documents, which previously existed in various electronic file formats, have been uniformly converted into a single word processing application. An Ethernet Local Area Network (LAN) has been installed and a competent network administrator hired. A document data base has been procured and installed on the file server. Further improvements are ongoing. The data base software enables rapid searches of existing documentation and retrieves documents with pinpoint accuracy. This capability means that an accurate, current operations baseline can be output for any system, component, or process. In many ways, the new focus on distributing current, correct, and complete information has yielded significant productivity and quality improvements and cost savings. This paper addresses the process of upgrading ATR Configuration Management-Document Control.

3121 (EGG-MS–9869) **Review of Savannah River Site K Reactor inservice inspection and testing restart program.** Anderson, M.T.; Hartley, R.S.; Kido, C. EG and G Idaho, Inc., Idaho Falls, ID (United States). Sep 1992. 33p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC07-76ID01570. Order Number DE93001959. Source: OSTI; NTIS; INIS; GPO Dep.

Inservice inspection (ISI) and inservice testing (IST) programs are used at commercial nuclear power plants to monitor the pressure boundary integrity and operability of components in important safety-related systems. The Department of Energy (DOE) - Office of Defense Programs (DP) operates a Category A (> 20 MW thermal) production reactor at the Savannah River Site (SRS). This report represents an evaluation of the ISI and IST practices proposed for restart of SRS K Reactor as compared, where applicable, to current ISI/IST activities of commercial nuclear power facilities.

3122 (EGG-NRRT–10350) **Preliminary design studies on the Broad Application Test Reactor.** Terry, W.J. (ed.); Terry, W.K.; Ryskamp, J.M.; Jahshan, S.N.; Fletcher, C.D.; Moore, R.L.; Leyse, C.F.; Ottewitte, E.H.; Motloch, C.G.; Lacy, J.M. EG and G

Idaho, Inc., Idaho Falls, ID (United States). Aug 1992. 75p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC07-76ID01570. Order Number DE93002038. Source: OSTI; NTIS; INIS; GPO Dep.

This report describes progress made at the Idaho National Engineering Laboratory during the first three quarters of Fiscal Year (FY) 1992 on the Laboratory-Directed Research and Development (LDRD) project to perform preliminary design studies on the Broad Application Test Reactor (BATR). This work builds on the FY-92 BATR studies, which identified anticipated mission and safety requirements for BATR and assessed a variety of reactor concepts for their potential capability to meet those requirements. The main accomplishment of the FY-92 BATR program is the development of baseline reactor configurations for the two conventional conceptual test reactors recommended in the FY-91 report. Much of the present report consists of descriptions and neutronics and thermohydraulics analyses of these baseline configurations. In addition, we considered reactor safety issues, compared the consequences of steam explosions for alternative conventional fuel types, explored a Molten Chloride Fast Reactor concept as an alternate BATR design, and examined strategies for the reduction of operating costs. Work planned for the last quarter of FY-92 is discussed, and recommendations for future work are also presented.

3123 (HW–3-2661) **Correlation analysis of water in 107 F.** Paas, H.J.; Bradford, B. Hanford Works, Richland, WA (United States). 23 Jun 1945. 6p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE93000328. Source: OSTI; NTIS (US Sales Only); GPO Dep.

This memorandum provides an analysis of data on the effects of various conditions and water content on activity of water as it enters the retention basin in 107 F.

3124 (HW–7-1936) **Consequences of high power levels.** Worthington, H. Hanford Works, Richland, WA (United States). 6 Jul 1945. 6p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE93002056. Source: OSTI; NTIS (US Sales Only); GPO Dep.

This memo discusses the effects of advancing to higher power levels of the 105 Piles (D-Pile). It is concluded that there is no technical reason against a cautious advance to higher powers; the units can be run at higher levels than their rating of 250 MW, or the additional reactivity that they will gain with time may be taken entirely in the form of lower peak temperatures and radiation levels. The decision as to what course to follow between these extremes involves such issues as the best use of uranium and the most effective separation of adequate amounts of product of proper quality.

3125 (HW–7-1948) **Pile power level.** Smith, M.H. Du Pont de Nemours (E.I.) and Co., Richland, WA (United States). 9 Jul 1945. 2p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE93002057. Source: OSTI; NTIS (US Sales Only); GPO Dep.

A memorandum prepared by the Technical Department discussing the technical considerations involved in raising Pile power above the present level of 280 M.W. was discussed. A meeting attended by W. O. Simon, B. H. Mackey, L. Squires, H. Worthington, C. N. Gross, W. E. Jordan and M. H. Smith. The details of this memorandum were reviewed and the plan proposed for operation of the piles subsequent to August 1, 1945 is discussed in this report.

3126 (HW–7-2744) **Procedure for improving temperature distribution via rods and columns – B Pile.** Menegus, R.L. Du Pont de Nemours (E.I.) and Co., Wilmington, DE (United States). Explosives Dept. 5 Oct 1945. 4p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE93002106. Source: OSTI; NTIS (US Sales Only); GPO Dep.

Since the development of relationships between rod changes and temperature shifts, the temperature distribution of the B Pile has been improved as much as possible by shifting the rods. Certain unbalances have been found which can only be removed by improvement of the poison pattern. At present the maximum imperfection in the B Pile is 5% diagonal quadrupole unbalance. An estimate of the poison pattern needed to correct these imperfections is given herein. This poison pattern has been calculated as an example of application of the principles and is not intended as a recommendation.

3127 (HW–7-3337) **Production Test No. 105-39-P – Special Irradiations: Final report.** Wende, C.W.J. Hanford Works, Richland, WA (United States). 28 Jan 1946. 3p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE93002105. Source: OSTI; NTIS (US Sales Only); GPO Dep.

A special slug containing 1 mg ^{237}Np was charged into Tube No. 3678 of the 105-B unit on Oct. 30, 1945 and was discharged on Jan. 20, 1946. The neutron exposure in this Position 20 was nvt 3.15×10^{19} n/cm^2 in the adjacent heavy metal.

3128 (HW–7-3834) **Production Test No. 305-9-P, poisoning effectiveness and uniformity of myrnalloy slugs: Final report.** Wende, C.W.J. Hanford Works, Richland, WA (United States). 2 Apr 1946. 4p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE93002059. Source: OSTI; NTIS (US Sales Only); GPO Dep.

This report discusses the poisoning effectiveness and uniformity of the first production batch of 33 myrnalloy slugs which was tested in the 305 Test Pile on February 26, 1946, prior to charging into the D Pile in accordance with Production Test No. 105-49-P, supplement A.

3129 (HW–7197) **Process tubes at B Pile.** Lewis, W.R. Hanford Works, Richland, WA (United States). 28 Jul 1947. 2p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE93002061. Source: OSTI; NTIS (US Sales Only); GPO Dep.

This memorandum discusses the roflanging of the corroded rear Van Stone flanges at the B Pile after cutting 3/8-inch off the rear gun barrel which should place the B Pile in a condition as good as, or better than that of the D or F Piles.

3130 (HW–9602) **Time requirements for current discharge operations.** Cabell, C.P. Hanford Works, Richland, WA (United States). 22 Apr 1948. 3p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE93000329. Source: OSTI; NTIS (US Sales Only); GPO Dep.

In order to evaluate the feasibility of segmental discharge equipment, it was necessary to determine the time required for segmental discharge during the current operating procedures. This memorandum details this time study.

3131 (HW–9603) **Inspection and replacement of Van Stone flanges, B, D, and F piles.** Hasga, J.A. Hanford Works, Richland, WA (United States). 23 Apr 1948. 5p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE93002062. Source: OSTI; NTIS (US Sales Only); GPO Dep.

Routine inspections of selected Van Stone flanges have been made at all three piles since start-up. In September, 1947, these inspections indicated that corrosion effects were becoming dangerously severe. Some of the flanges appeared to be corroied and pitted to a depth of two-thirds of the original flange thickness. To determine the extent and severity of the corrosion, residual flange thickness measurements were made on the flanges of about 64 scattered tubes. Included were front and rear flanges of tubes from all four orifice zones. Results of the survey indicated the immediate need for an extensive repair program to preclude the possibility of failure of some of the flanges.

3132 (HW–10232) **B Pile Start-Up Program.** Hanford Works, Richland, WA (United States). 24 Jun 1943. 4p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE93000983. Source: OSTI; NTIS (US Sales Only); GPO Dep.

This memorandum provides a schedule covering the Technical-Operational activities connected with the start-up of B-File.

3133 (HW–11426) **Start-up of the 100-B pile following 1569-B tube failure.** Carlton, G.B. Hanford Works, Richland, WA

(United States). 8 Nov 1948. 5p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE93002063. Source: OSTI; NTIS (US Sales Only); GPO Dep.

Tube 1569-B ruptured on September 22, 1948 and was replaced. Between the time of failure and final isolation of this tube, considerable water escaped into the graphite packing. As a result, the unit start-up and subsequent operation was quite different from that usually followed. This report has been prepared to summarize the observations and activities related to this operation.

3134 (HW–13184) **Pile operation at higher power.** Wende, C.W.J. Hanford Works, Richland, WA (United States). 31 Mar 1949. 5p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE93002141. Source: OSTI; NTIS (US Sales Only); GPO Dep.

This memorandum presents a summary of current technical considerations on the feasibility of operating the piles at higher powers. These were reviewed and are recorded here as a basis for further action to be taken by the Manufacturing Divisions.

3135 (HW–20342) **A review of water treatment technology as applied in the 100 Areas, Hanford Works.** Conley, W.R. Hanford Works, Richland, WA (United States). 23 Jan 1951. 7p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE93002142. Source: OSTI; NTIS (US Sales Only); GPO Dep.

Higher operating levels in the 100 Area piles have caused alarming increases in pile effluent activity and pressure drop through the process tubes. Projected additional increases in power level may not be possible unless the problems of film formation and pile effluent activity are overcome. Although a solution to these problems is not the responsibility of the Power Division, we do not have an interest in seeing that any proposed solution meets the test of operational practicability. Consequently, this was written in order that pertinent water treatment information may be readily available.

3136 (HW–20379) **Increased process water pressure to 105 buildings.** Measly, H.F. Hanford Works, Richland, WA (United States). 22 Feb 1951. 4p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE93002066. Source: OSTI; NTIS (US Sales Only); GPO Dep.

This document discusses increases in water pressure from the 190 Building process pumps which has been contemplated for a range of pressures up to 550 PSIG. The existing process pumps are dual units, consisting of a steam turbine driven primary pump operated: in series with an electric driven secondary pump. The secondary pumps installed in 100-B, D, F, and H Areas were designed for 400 PSIG working pressure, and were given factory hydrostatic tests of 600 PSIG. The 100-DR pumps were given factory hydrostatic tests of 650 PSIG. The Ingersoll-Rand Company advises that a working pressure of 425 PSIG is as high as they would-recommend for pump casing pressure on the secondary pumps. In consideration of problems incident to increased operating pressures, the immediate limiting factor is the total head pressure permissible on secondary pump casings. Other limiting factors are filter plant capacities, and 183 process water capacities.

3137 (HW–20425) **Pile modification resulting in increased power levels.** Carbon, M.W.; Fryar, R.M. Hanford Works, Richland, WA (United States). 10 Jul 1951. 37p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE93002067. Source: OSTI; NTIS (US Sales Only); GPO Dep.

The power output of the piles is being restricted primarily by three important limitations; those due to graphite temperatures, slug and tube corrosion and maximum power per tube or "boiling disease." The purpose of this document is to present means for increasing very appreciably the "boiling disease" limits. In addition, means for alleviating the corrosion limitations will be discussed.

3138 (HW–20841) **Pile level objectives.** Windsheimer, W. Hanford Works, Richland, WA (United States). 16 Apr 1951. 2p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE93002143. Source: OSTI; NTIS (US Sales Only); GPO Dep.

At the 100–300 Areas Steering Committee meeting of March 7, following a general discussion of pile level increases, the chairman pointed out the necessity for programming tentative level objectives as far in advance as possible so that the P and Service Divisions may proceed with the planning details incidental to making the necessary equipment changes. A committee consisting of Mr. Warren and Mr. McCullough was appointed to prepare an outline of pile level objectives and to determine the major equipment changes involved in attaining such levels.

3139 (HW–21728) **Removal of ruptured slug from tube No. 2169-B.** Baker, J.T. Hanford Works, Richland, WA (United States). 25 Jul 1951. 3p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE93002069. Source: OSTI; NTIS (US Sales Only); GPO Dep.

The 105-B Pile which was shut down on July 18, 1951 to permit removal of a ruptured uranium slug from tube No. 2169-B. The rupture was detected from effluent water monitor evidence and a survey of rear face pigtails. Removal was accomplished with the pneumatic charging machine using only normal pushing force.

3140 (HW–24273) **C-Pile recommended flow – Pressure characteristic curve and orifice pattern.** Spencer, H.G. Hanford Works, Richland, WA (United States). 29 Apr 1952. 14p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE93002074. Source: OSTI; NTIS (US Sales Only); GPO Dep.

Final approval of a flow-pressure characteristic curve and orifice pattern for C Pile is desired as soon as possible to allow the completion of orifice assemblies and parallit instrumentation. The presentation of a recommended flow-pressure curve and an orifice pattern has been delayed by a lack of experimental flow data on the C Pile flow system. Discussion with members of the C-431-B working committee and Pile Technology Unit personnel indicated that the use of flows higher than those recommended by the Reactor Unit, in HDC-2327, was desirable on the basis that the costs of supplying more water to C Pile than required by present outlet temperature limits will be small compared to the probable saving that can be made in reduction of corrosion and slug rupture frequency. Using this agreement as well as previous data and the assumption of low enrichment as a basis, a preliminary recommendation of a higher flow curve is presented.

3141 (HW–24848) **Recommended C Pile power level limits.** McEwen, L.H.; Lang, L.W. Hanford Works, Richland, WA (United States). 30 Jun 1952. 19p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE93002145. Source: OSTI; NTIS (US Sales Only); GPO Dep.

This purpose of this document is to summarize the existing or contemplated limits of C Pile power level and to recommend the rates of increase of power toward these limits during initial operation. In this report pile power level and limits are expressed in terms of tube power only.

3142 (HW–25012) **100 Areas water treatment specifications.** Greninger, A.B. Hanford Works, Richland, WA (United States). 11 Jul 1952. 4p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE93002076. Source: OSTI; NTIS (US Sales Only); GPO Dep.

This memorandum discussed review of the data from tests using alum in the treatment of pile process water, and using activated silica as a coagulant aid during period of low water temperature, which shows that this method should be substituted for the present method of treating pile process water in all 100 Areas. It was recommended that the water treatment procedures and specifications attached to this memorandum be initiated as standard practice in all 100 Areas as soon as it is possible to make the necessary equipment modifications and installations.

3143 (HW–25345) **Design scope: Activated silica-alum water treatment facilities, reactor areas B, D, F, DR and H.** Fox, J.M. Jr. Hanford Works, Richland, WA (United States). 14 Aug 1952. 25p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE93002146. Source: OSTI; NTIS (US Sales Only); GPO Dep.

It is the purpose of this document to describe the proposed modifications to the cooling water treatment process used in reactor areas B, D, F, DR and H.

3144 (HW–25618) **Effect of slug rupture considerations on C Pile power level limits.** Lang, L.W. Hanford Works, Richland, WA (United States). 15 Sep 1952. 8p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE93002147. Source: OSTI; NTIS (US Sales Only); GPO Dep.

This memorandum discusses slug rupture frequency which appears to be a factor that may limit the power level of C Pile. Since additional exposure of Group 8 uranium slugs has increased the available information on the behavior of material similar to that which will be charged into C Pile, a review of this tube power limitation has been made. Utilization of additional data has been possible by use of the revised method of calculating rupture rates discussed in reference (2).

3145 (HW–25704) **Water treatment during C Pile start up.** Woods, W.K. Hanford Works, Richland, WA (United States). 22 Sep 1952. 3p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE93002077. Source: OSTI; NTIS (US Sales Only); GPO Dep.

This memorandum details the recommendation of the Technical Section that the C Pile be started up using alum treated water to which has been added sodium dichromate at a concentration of 2 ppm., and that the pile be purged at monthly intervals despite the expected absence of film formation. During the initial months of operation the necessity of adding sodium dichromate and of purging the pile should be evaluated with the hope that these factors can be eliminated from the process. The reasons for this recommendation, and proposals for water treatment in the current operating piles are discussed.

3146 (HW–26395) **Evaluation of anodic films on process tube exteriors.** Dalrymple, R.S. General Electric Co., Richland, WA (United States). Hanford Atomic Products Operation. 4 Mar 1953. 77p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE93002149. Source: OSTI; NTIS (US Sales Only); GPO Dep.

The investigation reported in this document concerns itself with studies of the mechanism of corrosion on the exterior of process tubes and with studies of the protective qualities of anodic films which might prevent corrosion on the exterior of process tubes. Sections of process tubing coated with Aqua-Dag, a colloidal graphite suspension, were included in these tests for comparison purposes as present operating procedures call for the application of Aqua-Dag to the exterior of process tubes for lubrication purposes during the charging of tubes into the piles.

3147 (HW–27318) **Installation of reactor gas refrigeration system – 105-C, Project C-431.** Wells, H.T. Hanford Works, Richland, WA (United States). 5 Mar 1953. 6p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE93002079. Source: OSTI; NTIS (US Sales Only); GPO Dep.

It is recommended that the Design Committee approve the installation of a refrigeration system in the 105-C gas circulation system for removal of moisture from the reactor following a process tube leak as was previously approved by the C-431 Project Committed. Engineering studies show that this refrigeration system is necessary to provide sufficient water removal capacity in order that the water absorbing capacity of the system furnished by the silica gel towers will not be a limit to the rate at which a reactor can be rehabilitated following a serious leak.

3148 (HW–27392) **Photographs of Failure 250, the first C-pile rupture.** Chockie, L.J. Hanford Works, Richland, WA (United States). 12 Mar 1953. 2p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE93002151. Source: OSTI; NTIS (US Sales Only); GPO Dep.

This memorandum discusses four photographs of Failure 250, from Tube No. 2179-C, which are presented to show the type of failure as viewed in the 111-B cave. The first three photographs are successive rotations of the slug, illustrating the split-out portion at the base end of the piece. The fourth photo was focused on the split to show the bulging of the slug and the width of the opening.

3149 (HW–27778) **Maximum capacities of the 100-B water plant.** Strand, N.O. Hanford Works, Richland, WA (United States). 27 Apr 1953. 7p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE93002080. Source: OSTI; NTIS (US Sales Only); GPO Dep.

Increases in process water flows will be needed as the current program of increasing pile power levels continues. The future process water flows that will be required are known to be beyond the present maximum capacities of component parts of the water system. It is desirable to determine the present maximum capacities of each major component part so that plans can be mode for modifications and/or additions to the present equipment to meet future required flows. The apparent hydraulic limit of the present piles is about 68,000 gpm. This figure is based on a tube inlet pressure of 400 psi, a tube flow of 34 gpm, and 2,000 effective tubes. In this document the results of tests and calculations to determine the present maximum capacities of each major component part of the 100-B water system will be presented. Emergency steam operated pumps will not be considered as it is doubtful of year around operation of a steam driven pump could be economically justified. Some possible ways to increase the process water flows of each component part of the water system to the ultimate of 68,000 gpm are given.

3150 (HW–28076) **Production test number 105-519-E – Raising permissible outlet water temperatures of selected tubes at C Pile.** Goldsmith, S. Hanford Works, Richland, WA (United States). 25 May 1953. 7p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE93002068. Source: OSTI; NTIS (US Sales Only); GPO Dep.

This report describes the objective of this production test which is to simulate with a few tubes operation of the old piles with small water annulus at power levels in the range of 800–900 MW.

3151 (HW–30000-Del.) **1953 at Hanford.** General Electric Co., Richland, WA (United States). Hanford Atomic Products Operation. 15 Mar 1954. 46p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE93000323. Source: OSTI; NTIS (US Sales Only); GPO Dep.

The report summarizes Hanford's operation in 1953. The 38% increase in separated plutonium over the 1952 level was one measure of achievement. 1953's output was more than seven times that of 1947, the first full year of General Electric's operation of Hanford. Although much of this gain resulted from new reactors, some was due to improved safety devices, and much was due to increased knowledge of the controlling factors which permitted more efficient operation of old piles and better design of new ones. Year-by-year reductions in the cost of converting uranium to plutonium tell the real story of progress at Hanford. The annual production gains could have been made by building many 1944 model piles, though at fantastic cost. Contrasted with this is the actual case–a few new, improved piles plus more production from the old ones.

3152 (HW–33998-RD) **Reactor Section, Radiation Monitoring Sub-Section monthly report (administrative) November 1954: Rough draft.** Jerman, P.C. Hanford Atomic Products Operation, Richland, WA (United States). 3 Dec 1954. 4p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE93001731. Source: OSTI; NTIS (US Sales Only); GPO Dep.

This report presents results on radiation monitoring from the reactor section at the hanford reservation for November, 1954. Information is presented concerning radioactive effluent releases to the Columbia River, the activity of the water leaving the retention basins, slug failures, and radiation exposure to personnel.

3153 (HW–39900-Del.) **1955 at Hanford.** General Electric Co., Richland, WA (United States). Hanford Atomic Products Operation. [1956]. 30p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE93000324. Source: OSTI; NTIS (US Sales Only); GPO Dep.

This document summarizes activities of the Hanford Atomic Products Operation during 1955.

3154 (HW–44580-Del.) **Hanford Atomic Products Operation, monthly report, July 1956.** General Electric Co., Richland, WA (United States). Hanford Atomic Products Operation. 23 Aug 1956. 403p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE93000765. Source: OSTI; NTIS (US Sales Only); GPO Dep.

This document presents a summary of work and progress at the Hanford Engineer Works for July, 1956. The report is divided into sections by department. A plant wide general summary is included at the beginning of the report, after which the departmental summaries begin. The Manufacturing Department reports plant statistics, and summaries for the Metal Preparation, Reactor and Separation sections. The Engineering Department's section summarizes work for the Technical, Design, and Project Sections. Costs for the various departments are presented in the Financial Department's summary. The Medical, Radiological Sciences, Utilities and General Services, Employee and Public Relations, and Community Real Estate and Services departments have sections presenting their monthly statistics, work, progress, and summaries.

3155 (HW–53355-Del.) **Irradiation Processing Department monthly record report, October 1957.** General Electric Co., Richland, WA (United States). Hanford Atomic Products Operation. 20 Nov 1957. 145p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE93002441. Source: OSTI; NTIS (US Sales Only); GPO Dep.

This document details activities of the Irradiation Processing Department during the month of November, 1957. A general summary is included at the start of the report, after which the report is divided into the following sections: Research and Engineering Operations; Production and Reactor Operations; Facilities Engineering Operation; Employee Relations Operation; and Financial Operation.

3156 (HW–55905) **Hanford Laboratories Operation monthly activities report, April 1958.** General Electric Co., Richland, WA (United States). Hanford Atomic Products Operation. 15 May 1958. 148p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE93002504. Source: OSTI; NTIS (US Sales Only); GPO Dep.

This is the monthly report for the Hanford Laboratories Operation, May, 1958. Metallurgy, reactor fuels, chemistry, dosimetry, separation processes, reactor technology, financial activities, visits, biology operation, physics and instrumentation research, and employee relations are discussed.

3157 (HW–56229) **Fuels Preparation Department monthly report, May 1958.** Hanford Works, Richland, WA (United States). 17 Jun 1958. 42p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE93003519. Source: OSTI; NTIS (US Sales Only); GPO Dep.

This report describes the operation of the fuels preparation department for the month of May, 1958. Manufacturing employee relations, process development, plant improvements, and financial operations are discussed.

3158 (HW–60846-Del.) **Hanford Laboratories Operation monthly activities report, June 1959.** Hanford Atomic Products Operation, Richland, WA (United States). 15 Jul 1959. 176p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE93000769. Source: OSTI; NTIS (US Sales Only); GPO Dep.

This document provides details of activities of Hanford Laboratories Operation for the month of June 1959.

3159 (HW–61374) **Hanford Laboratories Operation monthly activities report, July 1959.** General Electric Co., Richland, WA (United States). Hanford Atomic Products Operation. 15 Aug 1959. 170p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE93002505. Source: OSTI; NTIS (US Sales Only); GPO Dep.

This is the monthly report for the Hanford Laboratories Operation, July, 1959. Metallurgy, reactor fuels, chemistry, dosimetry, separation processes, reactor technology, financial activities, visits, biology operation, physics and instrumentation research, and employee relations are discussed.

3160 (HW–63351) **Increased production study B, D, DR, F, H and C reactors.** Fifer, N.F.; Kempf, F.J. General Electric Co., Richland, WA (United States). Hanford Atomic Products Operation. 18 Apr 1960. 92p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE93000333. Source: OSTI; NTIS (US Sales Only); GPO Dep.

This document studies a broad study program which is currently in progress in Irradiation Processing Department to evaluate the technical and economic feasibility of various methods of obtaining increased production from the six older reactors (B, D, DR, F, H, and C Reactors). Due to time limitations this study has been in general terms only, but has indicated that considerable increased plant return can be obtained from an increased conversion ratio as well as from higher reactor power levels. The work performed by this Unit has been concerned with defining the reactor process component modifications, and process piping changes between the 105 Building valve pits and effluent basins which will be required to attain the production increases.

3161 (HW–64555-Del.) **Irradiation Processing Department monthly record report, March 1960.** General Electric Co., Richland, WA (United States). Hanford Atomic Products Operation. 21 Apr 1960. 104p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE93002442. Source: OSTI; NTIS (US Sales Only); GPO Dep.

This document details activities of the Irradiation Processing Department during the month of March, 1960. A general summary is included at the start of the report, after which the report is divided into the following sections: Research and Engineering Operations; Production and Reactor Operations; Facilities Engineering Operation; Employee Relations Operation; and Financial Operation.

3162 (HW–65013) **Irradiation Processing Department monthly report, April 1960.** General Electric Co., Richland, WA (United States). Hanford Atomic Products Operation. 19 May 1960. 109p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE93001740. Source: OSTI; NTIS (US Sales Only); GPO Dep.

This document details activities of the irradiation processing department during the month of April, 1960. A general summary is included at the start of the report, after which the report is divided into the following sections: Research and engineering Operations; Production and Reactor Operations; Facilities Engineering Operation; Employee Relations Operation; and Financial Operation.

3163 (HW–65527) **Irradiation Processing Department monthly report, May 1960.** Greninger, A.B. Hanford Works, Richland, WA (United States). 20 Jun 1960. 115p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE93000991. Source: OSTI; NTIS (US Sales Only); GPO Dep.

This document details activities of the irradiation processing department during the month of May, 1960. A general summary is included at the start of the report, after which the report is divided into the following sections: Research and Engineering Operations; Production and Reactor Operations; Facilities Engineering Operation; Employee Relations Operation; and Financial Operation.

3164 (HW–66296) **Irradiation Processing Department monthly report, July 1960.** General Electric Co., Richland, WA (United States). Hanford Atomic Products Operation. 12 Aug 1960. 85p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE93001741. Source: OSTI; NTIS (US Sales Only); GPO Dep.

This document details activities of the irradiation processing department during the month of July, 1960. A general summary is included at the start of the report, after which the report is divided into the following sections: Research and Engineering Operations; Production and Reactor Operations; Facilities Engineering Operation; Employee Relations Operation; and Financial Operation.

3165 (HW–67262) **Fuels Preparation Department monthly report, October 1960.** General Electric Co., Richland, WA (United States). Hanford Atomic Products Operation. 7 Nov 1960. 39p.

Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE93000327. Source: OSTI; NTIS (US Sales Only); GPO Dep.

This report describes the operation of the fuels preparation department for the month of October, 1960. Manufacturing, process development, employee relations, financial operations, and plant improvements are discussed.

3166 (HW–69835) **Irradiation Processing Department monthly report, May 1961.** General Electric Co., Richland, WA (United States). Hanford Atomic Products Operation. 15 Jun 1961. 81p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE93003174. Source: OSTI; NTIS (US Sales Only); GPO Dep.

This document details activities of the irradiation processing department during the month of May, 1961. A general summary is included at the start of the report, after which the report is divided into the following sections: Research and Engineering Operations; production and Reactor Operations; Facilities Engineering Operation; Employee Relations Operation; and NPR Reactor.

3167 (HW–71584) **Irradiation Processing Department monthly report, October 1961.** Air Force Occupational Measurement Center, Randolph AFB, TX (United States). 17 Nov 1961. 73p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE93001742. Source: OSTI; NTIS (US Sales Only); GPO Dep.

This document details activities of the irradiation processing department during the month of October, 1961. A general summary is included at the start of the report, after which the report is divided into the following sections: Research and Engineering Operations; Production and Reactor Operations; Facilities Engineering Operation; Employee Relations Operation; and Financial Operation.

3168 (HW–72179) **Irradiation Processing Department monthly report, December 1961.** General Electric Co., Richland, WA (United States). Hanford Atomic Products Operation. 15 Jan 1962. 72p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE93003571. Source: OSTI; NTIS; GPO Dep.

This document details activities of the irradiation processing department during the month of December, 1961. Al general summary is included at the start of the report, after which the report is divided into the following sections: Research and Engineering Operations: Production and reactor Operations; Facilities Engineering Operation; and NPR project.

3169 (HW–73153) **Irradiation Processing Department monthly report, March 1962.** General Electric Co., Richland, WA (United States). Hanford Atomic Products Operation. 15 Apr 1962. 65p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE93003572. Source: OSTI; NTIS; GPO Dep.

This document details activities of the irradiation processing department during the month of March, 1962. A general summary is included at the start of the report, after which the report is divided into the following sections: Research and Engineering Operations; Production and Reactor Operations; Facilities Engineering Operation; and NPR Project.

3170 (IAEA-TECDOC–643(v.1)) **Research reactor core conversion guidebook. V.1: Summary.** International Atomic Energy Agency, Vienna (Austria). Apr 1992. 113p. Order Number DE93607811. Source: OSTI; NTIS (US Sales Only); INIS.

In view of the proliferation concerns caused by the use of highly enriched uranium (HEU) and in anticipation that the supply of HEU to research and test reactors will be more restricted in the future, this guidebook has been prepared to assist research reactor operators in addressing the safety and licensing issues for conversion of their reactor cores from the use of HEU fuel to the use of low enriched uranium fuel. This Guidebook, in five volumes, addresses the effects of changes in the safety-related parameters of mixed cores and the converted core. It provides an information base which should enable the appropriate approvals processes for implementation of a specific conversion proposal, whether for a light or for a heavy water moderated research reactor. Refs, figs, bibliographies and tabs.

3171 (IAEA-TECDOC–643(v.2)) **Research reactor core conversion guidebook. V.2: Analysis (Appendices A-F).** International Atomic Energy Agency, Vienna (Austria). Apr 1992. 386p. Order Number DE93607344. Source: OSTI; NTIS (US Sales Only); INIS.

Volume 2 consists of detailed Appendices, covering safety analyses for generic 10 MW reactor, safety analysis - probabilistic methods, methods for preventing LOCA, radiological consequence analyses, examples of safety report amendments and safety specifications. Included in Volume 2 are example analyses for cores with with highly enriched uranium and low enriched uranium fuels showing differences that can be expected in the safety parameters and radiological consequences of postulated accidents. There are seven examples of licensing documents related to core conversion and two examples of methods for determining power limits for safety specifications in the document. Refs, figs, bibliographies and tabs.

3172 (IAEA-TECDOC–643(v.2), pp. 11-28) **Safety analyses for the IAEA generic 10 MW reactor.** International Atomic Energy Agency, Vienna (Austria); Internationale Atomreaktorbau GmbH (INTERATOM), Bergisch Gladbach (Germany). Apr 1992. In *Research reactor core conversion guidebook. V.2: Analysis (Appendices A-F).* 386p. Order Number DE93607344. Source: OSTI; NTIS (US Sales Only); INIS.

Design criteria, thermal-hydraulic performance, and selected safety analyses are provided for conversion of the IAEA generic 10 MW reactor from HEU to LEU fuel. The LEU fuel element design that was studied contains 20 plates with 1.0 mm thick U_3O_8-Al fuel meat, a uranium density of 3.0 g/cm^3, and 446 g ^{235}U. Detailed results are also provided for the transition phase from HEU to LEU fuel (mixed cores) based on specific safety criteria. (author). 1 ref., 14 figs, 5 tabs.

3173 (IAEA-TECDOC–643(v.2), pp. 29-51) **Safety analyses for HEU and LEU equilibrium cores and HEU-LEU transition core for the IAEA generic 10 MW reactor.** Matos, J.E. (Argonne National Lab., Argonne, IL (United States). RERTR Program); Freese, K.E. International Atomic Energy Agency, Vienna (Austria). Apr 1992. In *Research reactor core conversion guidebook. V.2: Analysis (Appendices A-F).* 386p. Order Number DE93607344. Source: OSTI; NTIS (US Sales Only); INIS.

Analyses are provided for the key safety parameters and transient behavior of the IAEA generic 10 MW reactor with HEU and LEU fuels. The LEU fuel element design that was studied contains 23 plates with 0.5 mm thick U_3Si_2-Al fuel meat, a uranium density of 4.5 g/cm^3, and 390 g ^{235}U. The performance and safety characteristics of equilibrium cores are studied first, followed by detailed results for each step of a gradual transition from HEU to LEU fuel. (author). 8 refs, 7 figs, 13 tabs.

3174 (IAEA-TECDOC–643(v.2), pp. 53-79) **Typical safety analyses for UZrH fuel - 10 MW core.** International Atomic Energy Agency, Vienna (Austria); General Atomics, San Diego, CA (United States). Apr 1992. In *Research reactor core conversion guidebook. V.2: Analysis (Appendices A-F).* 386p. Order Number DE93607344. Source: OSTI; NTIS (US Sales Only); INIS.

Typical safety analyses are provided for a 10-MW TRIGA LEU reactor using the 16-rod UZrH (45 wt-%) fuel cluster. Results include data on the prompt negative temperature coefficient and heat transfer parameters along with analyses for a start-up accident and a loss-of-flow accident. (author). 14 figs, 5 tabs.

3175 (IAEA-TECDOC–643(v.2), pp. 83-86) **Probabilistic methods in safety analysis and licensing.** Moss, T.J. (Australian Atomic Energy Commission Research Establishment, Lucas Heights (Australia). Lucas Heights Research Labs.); McCulloch, D.B. International Atomic Energy Agency, Vienna (Austria). Apr 1992. In *Research reactor core conversion guidebook. V.2: Analysis (Appendices A-F).* 386p. Order Number DE93607344. Source: OSTI; NTIS (US Sales Only); INIS.

A brief general review of the background related to the use of probabilistic risk assessment (PRA) in design and licensing is given

along with a brief discussion of the requirements for a comprehensive PRA approach to safety assessment and review for licensing purposes. (author). 3 refs.

3176 (IAEA-TECDOC–643(v.2), pp. 87-95) **Safety analysis - Probabilistic methods.** Baglin, C. (GEC Energy Systems Ltd., Leicester (United Kingdom)). International Atomic Energy Agency, Vienna (Austria). Apr 1992. In *Research reactor core conversion guidebook. V.2: Analysis (Appendices A-F).* 386p. Order Number DE93607344. Source: OSTI; NTIS (US Sales Only); INIS.

A simple example of the probabilistic method in accident analysis is applied to a flow blockage accident in a downflow pool reactor to illustrate the general concepts of this approach. (author). 7 refs, 5 figs, 2 tabs.

3177 (IAEA-TECDOC–643(v.2), pp. 97-121) **Application of probabilistic analysis techniques to a typical 10 MW MTR.** Allen, F.R. (UKAEA Safety and Reliability Directorate, Culcheth (United Kingdom)). International Atomic Energy Agency, Vienna (Austria). Apr 1992. In *Research reactor core conversion guidebook. V.2: Analysis (Appendices A-F).* 386p. Order Number DE93607344. Source: OSTI; NTIS (US Sales Only); INIS.

A detailed example is presented of the way in which probability analysis techniques may be applied to a typical 10 MW MTR. The steps necessary to enable an assessment of the probability and consequences of an accident sequence are outlined. Some detailed examples are given of the ways in which probabilities for particular accidental occurrences may be assessed from an analysis of the components of a system and a knowledge of their individual failure characteristics. (author). 10 refs, 5 figs, 4 tabs.

3178 (IAEA-TECDOC–643(v.2), pp. 125-129) **Engineered safety features against LOCA for the 'Democritos' reactor.** Chrysochoides, N.G. (Athens Univ. of Agricultural Sciences, Athens (Greece). Physics Lab.); Anoussis, J.N.; Mitsonias, C.A.; Papastergiou, C.N. International Atomic Energy Agency, Vienna (Austria). Apr 1992. In *Research reactor core conversion guidebook. V.2: Analysis (Appendices A-F).* 386p. Order Number DE93607344. Source: OSTI; NTIS (US Sales Only); INIS.

"Democritos" is a 5 MW swimming-pool type reactor. One safety concern of this type of reactor is a LOCA due to rupture either of a pipe of the primary cooling system or of an experimental beam tube. Existing engineered safety features against LOCA are described along with further solutions that are being considered. (author). 4 figs.

3179 (IAEA-TECDOC–643(v.2), pp. 131-137) **Engineered safety features against LOCA for the SAPHIR reactor.** Winkler, H. (Paul Scherrer Inst. (PSI), Villigen (Switzerland)). International Atomic Energy Agency, Vienna (Austria). Apr 1992. In *Research reactor core conversion guidebook. V.2: Analysis (Appendices A-F).* 386p. Order Number DE93607344. Source: OSTI; NTIS (US Sales Only); INIS.

SAPHIR is a 10 MW swimming-pool research reactor whose usual core contains 28-35 fuel elements. The most serious accident in this type of reactor is a LOCA which can occur either by a serious rupture in the primary cooling system or a break of a beam tube. Some of the engineered safety features against LOCA taken at SAPHIR are described. (author). 5 figs.

3180 (IAEA-TECDOC–643(v.2), pp. 139-148) **Engineered safety features against LOCA for the High Flux Reactor - Petten.** Chrysochoides, N.G. (Commission of the European Communities, Petten (Netherlands). Joint Research Centre, HFR Div.); Tas, A. International Atomic Energy Agency, Vienna (Austria). Apr 1992. In *Research reactor core conversion guidebook. V.2: Analysis (Appendices A-F).* 386p. Order Number DE93607344. Source: OSTI; NTIS (US Sales Only); INIS.

The High Flux Reactor - Petten is a 45 MW tank-type Materials Testing Reactor that is moderated and cooled by light water. The reactor core with its adjacent devices is contained in a closed vessel which is immersed in a pool of demineralized water. The engineered safety features against LOCA for both partial and complete uncovering of the core are described. (author). 7 figs.

3181 (IAEA-TECDOC–643(v.2), pp. 149-151) **ECCS used in DIDO and PLUTO.** Panter, R. (UKAEA Harwell Lab. (United Kingdom)). International Atomic Energy Agency, Vienna (Austria). Apr 1992. In *Research reactor core conversion guidebook. V.2: Analysis (Appendices A-F).* 386p. Order Number DE93607344. Source: OSTI; NTIS (US Sales Only); INIS.

DIDO and PLUTO are heavy water tank-type reactors with power levels of 25.5 MW. Measures are described that protect against failure of the smaller pipes in the primary system, and more importantly. against weld failure at the junction to a large pipe rather than in the small pipe itself. (author). 1 ref., 2 figs.

3182 (IAEA-TECDOC–643(v.2), pp. 251-256) **Safety review of KUCA conversion from HEU to MEU fuel.** Kanda, K. (Kyoto Univ., Kumatori, Osaka (Japan). Research Reactor Inst.); Nakagome, Y.; Hayashi, M. International Atomic Energy Agency, Vienna (Austria). Apr 1992. In *Research reactor core conversion guidebook. V.2: Analysis (Appendices A-F).* 386p. Order Number DE93607344. Source: OSTI; NTIS (US Sales Only); INIS.

An outline is provided of the items examined by the Japanese Government in its safety review for conversion of the KUCA core from HEU to MEU fuel. Results include a comparison of the neutronic characteristics of the core with HEU and MEU fuels, information on the integrity of MEU aluminide fuel, and an analysis of the worst case accident that was considered. (author). 5 figs, 2 tabs.

3183 (IAEA-TECDOC–643(v.2), pp. 257-267) **Safety analysis of JMTRC core conversion from HEU to MEU fuel.** Oyamada, R. (Japan Atomic Energy Research Inst., Tokai, Ibaraki (Japan)); Niibo, T.; Nagaoka, Y. International Atomic Energy Agency, Vienna (Austria). Apr 1992. In *Research reactor core conversion guidebook. V.2: Analysis (Appendices A-F).* 386p. Order Number DE93607344. Source: OSTI; NTIS (US Sales Only); INIS.

An outline is provided of main parts of the safety analysis for conversion of the JMTRC core from HEU to MEU fuel. Results include information on the fuel design, neutronic characteristics of the reactor core, postulated reactivity insertion accidents, and the maximum credible accident. (author). 5 figs, 7 tabs.

3184 (IAEA-TECDOC–643(v.2), pp. 269-311) **Safety analysis - Utilization of low enrichment uranium (LEU) fuel in the Ford Nuclear Reactor.** International Atomic Energy Agency, Vienna (Austria); Michigan Univ., Ann Arbor, MI (United States). Ford Nuclear Reactor. Apr 1992. In *Research reactor core conversion guidebook. V.2: Analysis (Appendices A-F).* 386p. Order Number DE93607344. Source: OSTI; NTIS (US Sales Only); INIS.

This analysis reviews the safety aspects of utilizing low enrichment uranium (LEU-less than 20% enrichment) fuel in the Ford Nuclear Reactor (FNR). A brief description of the proposed fuel is followed by an examination of fuel swelling, high temperature blistering, and failure data for similar operational and test fuels under operating conditions similar to those in the FNR. Fuel specifications have been developed with technical requirements identical to those for reactors which use equivalent fuel. Heat transfer characteristics are not examined in detail because fuel and coolant flow channel dimensions are identical to those in present FNR fuel. Core physics analyses show some variation in fast and thermal neutron flux distributions within the core and in the reflector regions. The available data and the analyses performed indicate that no reduction in safety margins are expected from utilizing LEU fuel in the FNR core. (author). 23 refs, 76 bibliographies, 14 figs, 10 tabs.

3185 (IAEA-TECDOC–643(v.2), pp. 313-319) **Modifications required by the OSIRIS core conversion.** International Atomic Energy Agency, Vienna (Austria); CEA Centre d'Etudes de Saclay, 91 - Gif-sur-Yvette (France). Apr 1992. In *Research reactor core conversion guidebook. V.2: Analysis (Appendices A-F).* 386p. Order Number DE93607344. Source: OSTI; NTIS (US Sales Only); INIS.

An outline is provided of the modifications required to substitute low enriched Caramel fuel in place of highly enriched aluminide fuel in the OSIRIS reactor core. A change in the fuel technology and some modifications of the reactor itself were required. (author).

3186 (IAEA-TECDOC–643(v.2), pp. 321-336) **The possible use of cermet fuel in the DIDO and PLUTO heavy-water research reactors.** Kennedy, T.D.A. (UKAEA Harwell Lab. (United Kingdom)). International Atomic Energy Agency, Vienna (Austria). Apr 1992. In *Research reactor core conversion guidebook. V.2: Analysis (Appendices A-F).* 386p. Order Number DE93607344. Source: OSTI; NTIS (US Sales Only); INIS.

International restrictions on the supply of highly enriched uranium have resulted in the requirement to fuel research reactors with a lower-enrichment uranium fuel. A study has been made of the feasibility of using low-enrichment fuels of a new type in the DIDO and PLUTO reactors. This work has been done as a contribution to the studies currently being carried out internationally on the implications of using lower-enrichment fuels in heavy-water-moderated research reactors. The uranium content of the U/Al alloy at present used cannot be increased sufficiently to maintain the requisite U^{235} content without undesirable effects on the physical properties of the alloy. A different type of fuel will therefore be required to maintain the desired nuclear characteristics. A possible solution to the problem is the use of a cermet (U_3O_8/Al) fuel material. Cermet fuel has poorer thermal conductivity than metallic fuel, and may also contain particles of the ceramic of a size that approaches the total thickness of the cermet core. We therefore have to consider both the average temperature of the centre of the fuel and whether large particles of the ceramic may be significantly hotter than the average. This paper describes a preliminary study of the feasibility of this concept from the heat-transfer and safety viewpoints. Calculations have been made for a cermet of 20%-enrichment 2.3g U/cm^3, used in a high-power element in a DIDO-type reactor. To accommodate the cermet, the cladding has been reduced in thickness to 0.318mm (0.0125 in) the core increasing to 1.044mm, but the fuel geometry is otherwise unchanged. It is concluded that from the heat-transfer viewpoint there is no problem during normal operation or the maximum credible power transient in these reactors. (author). 10 refs, 6 figs, 2 tabs.

3187 (IAEA-TECDOC–643(v.2), pp. 337-369) **Core conversion effects to the safety analysis of research reactors.** Anoussis, J.N. (National Research Centre for the Physical Sciences Democritos, Athens (Greece)); Chrysochoides, N.G.; Papastergiou, C.N. International Atomic Energy Agency, Vienna (Austria). Apr 1992. In *Research reactor core conversion guidebook. V.2: Analysis (Appendices A-F).* 386p. Order Number DE93607344. Source: OSTI; NTIS (US Sales Only); INIS.

This paper has been prepared in accordance with the proposed SAR format contained in the Summary of this guide book, and incorporates several conclusions and results presented in various sections of the guide book. The paper could be considered therefore, as an application-example of the guide book for the preparation of a SAR of a research reactor in the case of its core conversion from the use of high to low enriched uranium fuel. Although the 5 MW swimming pool "Democritos" research reactor (Greek Research Reactor-1) is used as an example for the various calculations of the SAR, the analysis is in many aspects of a more general nature (e.g. the analysis of MCA, DBA, Engineered Safety Features etc.) and can be applied not only to this particular reactor but to other similar reactors as well. The radiological consequences of the MCA and DBA are calculated as an application of the methodology presented in appendix D-3 "Estimation of Radiological Doses from Research Reactor Accidents". It is hoped that in this way, the present work can be of an assistance to several reactor operators. It should be noted though, that the present work is not in every sense a complete SAR to be submitted for licensing purposes, (e.g. no information on technical specifications, determination of safety limits or Q/A program, are included) but it contains the basic safety analysis considerations that a SAR for core conversion should include. (author). 23 refs, 14 figs, 10 tabs.

3188 (IAEA-TECDOC–643(v.2), pp. 371-372) **Summary - SAR amendments for testing prototype fuel elements in the FRG-2 reactor.** Krull, W. (GKSS-Forschungszentrum Geesthacht GmbH, Geesthacht-Tesperhude (Germany)). International Atomic Energy Agency, Vienna (Austria). Apr 1992. In *Research reactor core conversion guidebook. V.2: Analysis (Appendices A-F).* 386p. Order Number DE93607344. Source: OSTI; NTIS (US Sales Only); INIS.

For the Germany research reactor FRG-2, a licensing procedure was necessary for testing prototype fuel elements with reduced enrichment. This summary lists the points that were discussed between the reactor operator, independent experts and the licensing authority. (author). 1 ref.

3189 (IAEA-TECDOC–643(v.2), pp. 375-377) **Determination of power limits for technical specifications.** Baglin, C. (GEC Energy Systems Ltd., Leicester (United Kingdom)); Tas, A. International Atomic Energy Agency, Vienna (Austria). Apr 1992. In *Research reactor core conversion guidebook. V.2: Analysis (Appendices A-F).* 386p. Order Number DE93607344. Source: OSTI; NTIS (US Sales Only); INIS.

An outline is provided of the considerations necessary to determine the maximum operating power, usually set by flow instability burnout, for core conversion, from HEU to LEU fuel without changing the primary cooling circuit. (author). 1 fig.

3190 (IAEA-TECDOC–643(v.2), pp. 379-386) **Nominal power limits of the HFR for LEU elements with a reduced number of thicker fuel plates.** Tas, A. (Netherlands Energy Research Foundation (ECN), Petten (Netherlands)). International Atomic Energy Agency, Vienna (Austria). Apr 1992. In *Research reactor core conversion guidebook. V.2: Analysis (Appendices A-F).* 386p. Order Number DE93607344. Source: OSTI; NTIS (US Sales Only); INIS.

A procedure is provided for determining the new power limits (based on the margin against flow-instability-induced burnout) for HEU to LEU core conversion cases in which the fuel element design is changed to include a reduced number of thicker fuel plates. Consequences of core conversion are investigated for a specific reactor (HFR Petten) for a variety of LEU fuel element design options. (author). 5 refs, 1 fig., 3 tabs.

3191 (IAEA-TECDOC–643(v.3)) **Research reactor core conversion guidebook. V. 3: Analytical verification (Appendices G and H).** International Atomic Energy Agency, Vienna (Austria). Apr 1992. 368p. Order Number DE93607812. Source: OSTI; NTIS (US Sales Only); INIS.

Volume 3 consists of Appendix G which contains detailed results of a safety-related benchmark problem for an idealized reactor and Appendix H which contains detailed comparisons of calculated and measured data for actual cores with moderately enriched uranium and low enriched uranium fuels. The results of the benchmark calculations in Appendix G are summarized in Chapter 7 of Volume 1 and the results of the comparisons between calculations and measurements are summarized in Chapter 8 of Volume 1. Both the approaches described in these appendices are very useful in ensuring that the calculational methods employed in the preparation of a Safety Report are accurate. As a first step, it is recommended that reactor operators/physicists use their own methods and codes to first calculate the benchmark problem, and then compare the results of calculations with measurements in their own reactor or in one of the reactors for which measured data is available in Appendix H. (author). Refs, figs and tabs.

3192 (IAEA-TECDOC–643(v.3), pp. 15-64) **Safety-related benchmark calculations for MTR-type reactors with HEU, MEU and LEU fuels.** Matos, J.E. (Argonne National Lab., IL (United States)); Pennington, E.M.; Freese, K.E.; Woodruff, W.L. International Atomic Energy Agency, Vienna (Austria). Apr 1992. In *Research reactor core conversion guidebook. V. 3: Analytical verification (Appendices G and H).* 368p. Order Number DE93607812. Source: OSTI; NTIS (US Sales Only); INIS.

Results are provided for the safety-related benchmark problem with HEU, MEU, and LEU fuels. Additional results include reactivity worths and power peaking factors with partially-inserted control rods. Comparisons of calculations and measurements for selected SPERT I transients are given along with results for self-limiting transients in the HEU and LEU benchmark cores. (author). 8 refs, 19 figs, 36 tabs.

3193 (IAEA-TECDOC–643(v.3), pp. 65-89) **Benchmark calculations.** International Atomic Energy Agency, Vienna (Austria);

Internationale Atomreaktorbau GmbH (INTERATOM), Bergisch Gladbach (Germany). Apr 1992. In *Research reactor core conversion guidebook. V. 3: Analytical verification (Appendices G and H).* 368p. Order Number DE93607812. Source: OSTI; NTIS (US Sales Only); INIS.

Results are provided for the safety-related benchmark problem with HEU and LEU fuels. Additional results include a comparison of decay heat power versus shutdown time in the HEU and LEU cores and a comparison of the reactivity worths of an oval absorber and a fork-type absorber. (author). Figs and tabs.

3194 (IAEA-TECDOC–643(v.3), pp. 91-105) **IAEA safety-related benchmark calculations.** Naito, Y. (Japan Atomic Energy Research Inst., Tokai, Ibaraki (Japan)); Kurosawa, M.; Komuro, Y.; Oyamada, R.; Nagaoka, Y. International Atomic Energy Agency, Vienna (Austria). Apr 1992. In *Research reactor core conversion guidebook. V. 3: Analytical verification (Appendices G and H).* 368p. Order Number DE93607812. Source: OSTI; NTIS (US Sales Only); INIS.

The results of static and transient calculations are provided for the IAEA safety-related benchmark problem. (author). 4 refs, 7 figs, 11 tabs.

3195 (IAEA-TECDOC–643(v.3), pp. 11-14) **Specifications for the safety-related benchmark problem.** International Atomic Energy Agency, Vienna (Austria). Apr 1992. In *Research reactor core conversion guidebook. V. 3: Analytical verification (Appendices G and H).* 368p. Order Number DE93607812. Source: OSTI; NTIS (US Sales Only); INIS.

Detailed specifications are described for a safety-related benchmark problem to compare calculational methods used in various research centres. The reactor description is the same one utilized for the benchmark problem solved in IAEA-TECDOC-233, except for a change in the description of the central flux trap. Parameters specified to be calculated include kinetics parameters, reactivity feedback coefficients, power peaking factors, control rod worths, and several transients. (author).

3196 (IAEA-TECDOC–643(v.3), pp. 107-123) **Safety-related benchmark calculations for MTR reactors.** Amato, H. (Paul Scherrer Inst. (PSI), Villigen (Switzerland)); Winkler, H.; Zeis, J. International Atomic Energy Agency, Vienna (Austria). Apr 1992. In *Research reactor core conversion guidebook. V. 3: Analytical verification (Appendices G and H).* 368p. Order Number DE93607812. Source: OSTI; NTIS (US Sales Only); INIS.

Results of the calculated temperature coefficients and dynamic parameters for the IAEA benchmark core are given for HEU, MEU and LEU fuels. Some comparison of the calculated values with experimental data is also presented. (author). 12 refs, 5 figs, 12 tabs.

3197 (IAEA-TECDOC–643(v.3), pp. 125-148) **Calculations for the safety-related benchmark problem.** International Atomic Energy Agency, Vienna (Austria); Junta de Energia Nuclear, Madrid (Spain). Apr 1992. In *Research reactor core conversion guidebook. V. 3: Analytical verification (Appendices G and H).* 368p. Order Number DE93607812. Source: OSTI; NTIS (US Sales Only); INIS.

Results are provided for the safety-related benchmark problem with HEU and LEU fuels. (author). 13 refs, 24 figs, 12 tabs.

3198 (IAEA-TECDOC–643(v.3), pp. 149-156) **Self-limiting transients in heavy water moderated reactors.** Connolly, J.W. (Australian Atomic Energy Commission, Lucas Heights, New South Wales (Australia). Lucas Heights Research Lab.); Harrington, B.V.; McCulloch, D.B. International Atomic Energy Agency, Vienna (Austria). Apr 1992. In *Research reactor core conversion guidebook. V. 3: Analytical verification (Appendices G and H).* 368p. Order Number DE93607812. Source: OSTI; NTIS (US Sales Only); INIS.

A brief description is provided of the methods and models for reactivity transient calculations in heavy water moderated research reactors as a supplement to the heavy water reactor benchmark problem discussed in IAEA-TECDOC-324. These methods and models were validated by comparison with experimental transient data from the SPERT II BD22/24 heavy water moderated core. Experimental and calculated transient parameters for this core are compared. (author). 7 refs, 4 figs, 1 tab.

3199 (IAEA-TECDOC–643(v.3), pp. 159-168) **Critical experiments in the Isis reactor with the caramel fuel element.** International Atomic Energy Agency, Vienna (Austria); CEA Centre d'Etudes de Saclay, 91 - Gif-sur-Yvette (France). Apr 1992. In *Research reactor core conversion guidebook. V. 3: Analytical verification (Appendices G and H).* 368p. Order Number DE93607812. Source: OSTI; NTIS (US Sales Only); INIS.

Neutron tests of the caramel type UO_2 fuel were conducted in Isis in 1979. The new fuel elements of this type have been used since 1980 in Osiris, where they replaced the highly enriched U-A1 fuel. The Isis tests were preceded by calculations, whose results are compared with those obtained by measurements. (author). 2 refs, tabs.

3200 (IAEA-TECDOC–643(v.3), pp. 169-181) **KUCA critical experiments using medium enriched uranium fuel.** Kanda, K. (Kyoto Univ., Kumatori, Osaka (Japan). Research Reactor Inst.); Shiroya, S.; Hayashi, M.; Kobayashi, K.; Nakagome, Y.; Shibata, T. International Atomic Energy Agency, Vienna (Austria). Apr 1992. In *Research reactor core conversion guidebook. V. 3: Analytical verification (Appendices G and H).* 368p. Order Number DE93607812. Source: OSTI; NTIS (US Sales Only); INIS.

In accordance with the joint ANL-KURRI program, the critical experiments using MEU fuel in the KUCA, a light-water-moderated and heavy-water-reflected single-core, were started in May, 1981. In advance of the critical experiments, the MEU fuel elements and the boron loaded side-plates were fabricated by CERCA in France. The first critical state of the core using MEU fuel was achieved at 3:12 p.m., May 12, 1981. After that, several experiments were performed. The paper provides the results of measurements concerning the critical approach, the reactivity effects of side-plates containing boron burnable-poison, the space dependent effects of void reactivities and the temperature reactivity coefficients. These data will be used to examine the computer code systems in various countries and also used for core conversion of the KUHFR from HEU to MEU. (author). 9 refs, 9 figs, 2 tabs.

3201 (IAEA-TECDOC–643(v.3), pp. 183-192) **Analysis of the KUCA MEU experiments using the ANL code system.** Shiroya, S. (Kyoto Univ., Kumatori, Osaka (Japan). Research Reactor Inst.); Hayashi, M.; Kanda, K.; Shibata, T.; Woodruff, W.L.; Matos, J.E. International Atomic Energy Agency, Vienna (Austria). Apr 1992. In *Research reactor core conversion guidebook. V. 3: Analytical verification (Appendices G and H).* 368p. Order Number DE93607812. Source: OSTI; NTIS (US Sales Only); INIS.

Critical experiments using MEU fuel in the KUCA, a light-water-moderated and heavy-water-reflected single-core, were started in May 1981. This paper provides some results on the analysis of the KUCA critical experiments using the ANL code system. The critical mass for HEU and MEU single-cores and the boron burnable-poison effects for MEU cores were analysed. Five-group constants were generated using the EPRI-CELL code and two dimensional diffusion calculations were performed using the DIF3D code. For the analysis on the critical mass, a two-dimensional finite-element diffusion code (2D-FEM-KUR) was also applied and the results compared with the DIF3D (2D) code. (author). 17 refs, 9 figs, 4 tabs.

3202 (IAEA-TECDOC–643(v.3), pp. 193-200) **Analysis of KUCA MEU cores by the JAERI SRAC code system.** Mori, T. (Japan Atomic Energy Research Inst., Tokai, Ibaraki (Japan)); Tsuchihashi, K. International Atomic Energy Agency, Vienna (Austria). Apr 1992. In *Research reactor core conversion guidebook. V. 3: Analytical verification (Appendices G and H).* 368p. Order Number DE93607812. Source: OSTI; NTIS (US Sales Only); INIS.

As part of the Japanese RERTR Program, a series of calculations using the JAERI SRAC code system were performed for the KUCA critical experiments with MEU fuel. Parameters studied include critical masses, the mass coefficient, boron plate reactivities, and the reactivities due to void pipes inserted in the central water island. (author). 5 refs, 5 figs, 5 tabs.

3203 (IAEA-TECDOC–643(v.3), pp. 201-209) **Measurements of neutron flux distributions in a medium enriched uranium core.** Shiroya, S. (Kyoto Univ., Kumatori, Osaka (Japan). Research

Reactor Inst.); Fukui, H.; Senda, Y.; Hayashi, M.; Kobayashi, K. International Atomic Energy Agency, Vienna (Austria). Apr 1992. In *Research reactor core conversion guidebook. V. 3: Analytical verification (Appendices G and H).* 368p. Order Number DE93607812. Source: OSTI; NTIS (US Sales Only); INIS.

Neutron flux distributions were measured using the foil activation technique as part of single-core experiments in the C-core of the KUCA with MEU fuel in order to validate a computer code system developed in cooperation with JAERI. The single cylindrical core was light-water-moderated and heavy-water-reflected. Relative flux distributions were obtained with and without a void in the light-water moderator at the center of the reactor. The values of reflector savings were obtained for a few positions in the core without the void. Comparisons of measured and calculated data are presented. (author). 5 refs, 11 figs, 1 tab.

3204 (IAEA-TECDOC–643(v.3), pp. 211) **Effect of reducing fuel enrichment on the void reactivity. Pt. 1 Experimental study.** Fukui, H. (Kyoto Univ. (Japan). Faculty of Engineering); Senda, Y.; Mishima, K.; Shiroya, S.; Hayashi, M.; Kanda, K. International Atomic Energy Agency, Vienna (Austria). Apr 1992. In *Research reactor core conversion guidebook. V. 3: Analytical verification (Appendices G and H).* 368p. Order Number DE93607812. Source: OSTI; NTIS (US Sales Only); INIS.

The full text of this paper was published in Nuclear Technology, Vol. 70 (Sep 1985).

Reactivity of void in the channels between the fuel plates is measured, and the impact of core conversion from using HEU to MEU fuel in the light-water-moderated cylindrical core with heavy water reflector is investigated on this quantity at the Kyoto University Critical Assembly. The void was generated in the flow channels by producing nitrogen gas bubbles through a small needle-like nozzle and the reactivity effect was measured. The void fraction was measured in an out-of-pile experiment. The results indicate that the void effect on reactivity is slightly larger (more negative) in the MEU core than in the HEU core. It is also shown that the interference effect on reactivity by bubbling in two adjacent channels simultaneously is within the experimental error. (author). Abstract only.

3205 (IAEA-TECDOC–643(v.3), pp. 213) **Effect of reducing fuel enrichment on the void reactivity. Pt. 2 Analytical study.** Senda, Y. (Kyoto Univ. (Japan). Faculty of Engineering); Shiroya, S.; Hayashi, M.; Kanda, K. International Atomic Energy Agency, Vienna (Austria). Apr 1992. In *Research reactor core conversion guidebook. V. 3: Analytical verification (Appendices G and H).* 368p. Order Number DE93607812. Source: OSTI; NTIS (US Sales Only); INIS.

The full text of this paper was published in Nuclear Technology, Vol. 70 (Sep 85).

The results of analyses on the void reactivity measurements performed in the Kyoto University Critical Assembly using MEU fuel as well as HEU fuel are provided. In consideration of the heterogeneity of a complex core, four-group constants were generated by SRAC, a standard thermal reactor code system for reactor design and analysis at the Japan Atomic Energy Research Institute. The eigenvalue and perturbation calculations were subsequently performed by the 2D-FEM-KUR code, which is a two-dimensional diffusion code based on the finite element method. The calculated eigenvalue k_{eff} agreed with the measured value to within 0.5% in the calculated-to-experiment ratio. The void reactivity calculated by perturbation theory approximately reproduced the experimental data including the spatial dependence. The discrepancy between the calculated and measured void reactivity was $<0.05 \times 10^{-3}$ $\Delta k/k$ per voided flow channel. (author). Abstract only.

3206 (IAEA-TECDOC–643(v.3), pp. 215-224) **Study on temperature coefficients of MEU and HEU cores in the KUCA.** Kanda, K. (Kyoto Univ., Kumatori, Osaka (Japan). Research Reactor Inst.); Shiroya, S.; Mori, M.; Hayashi, M.; Shibata, T. International Atomic Energy Agency, Vienna (Austria). Apr 1992. In *Research reactor core conversion guidebook. V. 3: Analytical verification (Appendices G and H).* 368p. Order Number DE93607812. Source: OSTI; NTIS (US Sales Only); INIS.

Recently, measurements of the temperature reactivity coefficients were performed in the KUCA in succession to the study on void reactivity effects. The objective cores of study were light-water-moderated and heavy-water reflected ones loaded with HEU or MEU fuel. The following effects on the temperature coefficients were investigated for the range from 20 deg. C through 70 deg. C: (1) the reduction in fuel enrichment, (2) the fuel loading pattern, and (3) the existence of boron burnable poison. The measured data were analyzed using the SRAC system to assess the computational technique for the temperature effects on reactivity. Through the present study, no remarkable difference was observed between the temperature effects in HEU and MEU cores. It was found that the difference in the core configuration causes a much greater effect on this quantity than the other differences including the fuel enrichment. The calculated results agree approximately with the experimental data. (author). 17 refs, 12 figs.

3207 (IAEA-TECDOC–643(v.3), pp. 225-236) **Study on temperature coefficient of reactivity in KUCA light-water moderated and reflected core - effect of M/F ratio and core shape on this quantity.** Kanda, K. (Kyoto Univ., Kumatori, Osaka (Japan). Research Reactor Inst.); Shiroya, S.; Mori, M.; Shibata, T. International Atomic Energy Agency, Vienna (Austria). Apr 1992. In *Research reactor core conversion guidebook. V. 3: Analytical verification (Appendices G and H).* 368p. Order Number DE93607812. Source: OSTI; NTIS (US Sales Only); INIS.

Both the experimental and analytical studies have been performed on the temperature coefficient of reactivity in the KUCA light-water moderated and reflected core loaded with HEU fuel. The temperature effect on reactivity was measured for the range from 20 deg. C through 70 deg. C to investigate separately the effects of the M/F ratio and the core shape on this quantity. The results of both the eigenvalue and perturbation calculations by the SRAC code system approximately reproduced the experimental data. It was found that the contribution of the core region was negative to the temperature coefficient due to the degradation of moderation, whereas that of the reflector region was positive due to the decrease in neutron absorption. The positive contribution of the reflector region became larger as the M/F ratio became smaller and the core shape became more slender. (author). 2 refs, 15 figs, 4 tabs.

3208 (IAEA-TECDOC–643(v.3), pp. 237-245) **Critical experiments of the JMTRC MEU cores. Pt. 1.** Nagaoka, Y. (Japan Atomic Energy Research Inst., Oarai, Ibaraki (Japan). Oarai Research Establishment); Takeda, K.; Shimakawa, S.; Koike, S.; Oyamada, R. International Atomic Energy Agency, Vienna (Austria). Apr 1992. In *Research reactor core conversion guidebook. V. 3: Analytical verification (Appendices G and H).* 368p. Order Number DE93607812. Source: OSTI; NTIS (US Sales Only); INIS.

The JMTRC, the critical facility of the Japan Materials Testing Reactor (JMTR), went critical on August 29, 1983, with 14 medium enriched uranium (MEU, 45%) fuel elements. Experiments are now being carried out to measure the change in various reactor characteristics between the previous HEU core and the new MEU fueled core. This paper describes the results obtained thus far on critical mass, excess reactivity, control rod worths and flux distribution, including preliminary neutronics calculations for the experiments using the SRAC code. (author). 2 refs, 7 figs, 4 tabs.

3209 (IAEA-TECDOC–643(v.3), pp. 247-254) **Critical experiments of the JMTRC MEU cores. Pt. 2.** Shimakawa, S. (Japan Atomic Energy Research Inst., Oarai, Ibaraki (Japan). Oarai Research Establishment); Nagaoka, Y.; Koike, S.; Takeda, K.; Komukai, B.; Oyamada, R. International Atomic Energy Agency, Vienna (Austria). Apr 1992. In *Research reactor core conversion guidebook. V. 3: Analytical verification (Appendices G and H).* 368p. Order Number DE93607812. Source: OSTI; NTIS (US Sales Only); INIS.

Critical experiments in the Japan Materials Testing Reactor Critical facility (JMTRC) with medium-enrichment-uranium (MEU, 45%) fuel elements have been carried out. The purposes of the experiments are to obtain nuclear characteristics and to validate neutronics calculation performed by SRAC code system used for analyzing the JMTR MEU core. This paper describes the results of experiments, such as reactor kinetics parameters, shut-down margin and void coefficient following the previous paper presented at RERTR meeting, 1983. The calculated results are in satisfactory

agreement with the measured results. It is indicated that the changes of nuclear characteristics due to the core conversion from the HEU to the MEU core give no serious problem from the viewpoint of reactor safety. (author). 4 refs, 5 figs, 6 tabs.

3210 (IAEA-TECDOC–643(v.3), pp. 255-273) **Comparison of calculations with measurements in the FNR full-core LEU demonstration reactor.** International Atomic Energy Agency, Vienna (Austria); Michigan Univ., Ann Arbor, MI (United States). Ford Nuclear Reactor; Argonne National Lab., IL (United States). Apr 1992. In *Research reactor core conversion guidebook. V. 3: Analytical verification (Appendices G and H).* 368p. Order Number DE93607812. Source: OSTI; NTIS (US Sales Only); INIS.

As part of the U.S. RERTR Program, a full core demonstration with LEU fuel began in December 1981 in the 2 MW Ford Nuclear Reactor (FNR) at the University of Michigan. This appendix compares some of the experimental data with analytical calculations based, for the most part, on three dimensional diffusion theory. The critical configuration, control rod worths, axial rhodium reaction rate profiles and thermal flux distributions have been calculated and compared with measurements. (author). 8 refs, 20 figs, 12 tabs.

3211 (IAEA-TECDOC–643(v.3), pp. 275-283) **Analysis of critical experiments of FNR LEU cores.** Arigane, K. (Japan Atomic Energy Research Inst., Tokai, Ibaraki (Japan)); Tsuchihashi, K. International Atomic Energy Agency, Vienna (Austria). Apr 1992. In *Research reactor core conversion guidebook. V. 3: Analytical verification (Appendices G and H).* 368p. Order Number DE93607812. Source: OSTI; NTIS (US Sales Only); INIS.

An analysis has been done of the critical experiments in the LEU cores of the FNR to validate the calculational method, and accuracy of the neutronic design for the core conversion of JRR-4 from HEU to LEU fuel using the JAERI SRAC code system. This report describes the calculational process, the results of calculation for the critical mass and the control rod worths, and comparisons with the experimental values. Agreement between calculated and experimental values is satisfactory. (author). 6 refs, 6 figs, 4 tabs.

3212 (IAEA-TECDOC–643(v.3), pp. 285-296) **Analytical support for the ORR whole-core LEU U_3Si_2-Al fuel demonstration.** Bretscher, M.M. (Argonne National Lab., IL (United States)). International Atomic Energy Agency, Vienna (Austria). Apr 1992. In *Research reactor core conversion guidebook. V. 3: Analytical verification (Appendices G and H).* 368p. Order Number DE93607812. Source: OSTI; NTIS (US Sales Only); INIS.

Analytical methods used to analyze neutronic data from the whole-core LEU fuel demonstration in the Oak Ridge Research Reactor are briefly discussed. Calculated eigenvalues corresponding to measured critical control rod positions are presented for each core used in the gradual transition from all HEU to an LEU configuration. Some calculated and measured results, including B_{eff}/l_p, are compared for HEU and LEU fresh fuel criticals. Finally, the perturbing influences of the six voided beam tubes on certain core parameters are examined. For reasons yet to be determined, differential shim rod worths are not well-calculated in partially burned cores. (author). 12 refs, 3 figs, 5 tabs.

3213 (IAEA-TECDOC–643(v.3), pp. 297-304) **Comparison of calculated and measured irradiated wire data for HEU and mixed HEU/LEU cores in the ORR.** Cornella, R.J. (Argonne National Lab., IL (United States)); Bretscher, M.M.; Hobbs, R.W. International Atomic Energy Agency, Vienna (Austria). Apr 1992. In *Research reactor core conversion guidebook. V. 3: Analytical verification (Appendices G and H).* 368p. Order Number DE93607812. Source: OSTI; NTIS (US Sales Only); INIS.

Low power wire activations are being performed in the Oak Ridge Research Reactor (ORR) as part of the whole-core LEU demonstration experiments. Calculations of the demonstration cores, including simulation of the wire activations, are being performed at Argonne National Laboratory (ANL). This paper presents the results of comparisons for 293 wires from five cores and shows that, on the average, the integrated activities agree within 6%. (author). 2 refs, 6 figs.

3214 (IAEA-TECDOC–643(v.3), pp. 305-331) **Measurements and analysis of critical assemblies for research reactors with mixed enrichments.** Deen, J.R. (Argonne National Lab., IL (United States)); Snelgrove, J.L.; Hobbs, R.W. International Atomic Energy Agency, Vienna (Austria). Apr 1992. In *Research reactor core conversion guidebook. V. 3: Analytical verification (Appendices G and H).* 368p. Order Number DE93607812. Source: OSTI; NTIS (US Sales Only); INIS.

A series of experiments with MEU and LEU fuel elements in the HEU- fueled Pool Critical Assembly at ORNL were performed in order to study the effects on excess reactivity and power density distributions in mixed-enrichment cores. This paper reports the results of these measurements and the subsequent validation calculations performed at ANL. (author). 5 refs, 30 figs, 7 tabs.

3215 (IAEA-TECDOC–643(v.3), pp. 333-340) **Comparison of calculations and measurements of MEU fuel in the SAPHIR reactor.** Winkler, H. (Paul Scherrer Inst. (PSI), Villigen (Switzerland)); Zeis, J. International Atomic Energy Agency, Vienna (Austria). Apr 1992. In *Research reactor core conversion guidebook. V. 3: Analytical verification (Appendices G and H).* 368p. Order Number DE93607812. Source: OSTI; NTIS (US Sales Only); INIS.

In a 4 x 4 core arrangement each standard element (93% enrichment $\approx$ 280 g U-235, 23 plates) has been replaced by a MEU-element with 320 g U-235, 45% enrichment. The reactivity difference has been determined over the fine control rod position. The same core configuration was calculated with the two dimensional diffusion code CODIFF in order to obtain the difference in k_{eff} resp. ρ. (author). 2 refs, 3 figs, 1 tab.

3216 (IAEA-TECDOC–643(v.3), pp. 341-348) **Comparisons between calculated and measured flux and reactivity in HEU, MEU and LEU fuel elements in DR-3 at Riso.** Haack, K. (Risoe National Lab., Roskilde (Denmark)). International Atomic Energy Agency, Vienna (Austria). Apr 1992. In *Research reactor core conversion guidebook. V. 3: Analytical verification (Appendices G and H).* 368p. Order Number DE93607812. Source: OSTI; NTIS (US Sales Only); INIS.

As part of the investigations to determine the consequences of conversion of the DR-3 reactor to lower enrichment, three MEU and three LEU fuel elements were irradiated to normal burnup (50-60%). Full axial thermal and fast neutron flux density measurements were made in the test elements and all other accessible fuel elements in the core during the test periods, and reactivity measurements were made at the loading and at the discharge of every test element. These measurements were then compared with calculations. (author). 4 refs, 1 fig., 3 tabs.

3217 (IAEA-TECDOC–643(v.3), pp. 349-357) **Comparison of calculations with measurements of control rod worths in the HEU RA-2 reactor. Pt. 1.** Gomez, A. (Comision Nacional de Energia Atomica, Buenos Aires (Argentina)); Lerner, A.M.; Testoni, J.; Waldman, R. International Atomic Energy Agency, Vienna (Austria). Apr 1992. In *Research reactor core conversion guidebook. V. 3: Analytical verification (Appendices G and H).* 368p. Order Number DE93607812. Source: OSTI; NTIS (US Sales Only); INIS.

In Part 1 calculations are compared with the reactivity worth of strongly absorbing materials measured in the RA-2 reactor in order to verify the calculational methods. (author). 7 refs, 3 figs, 5 tabs.

3218 (IAEA-TECDOC–643(v.3), pp. 358-360) **Uses of the method of computing control rod worths in the RA-3 reactor with HEU and LEU fuels. Pt. 2.** Lerner, A.M. (Comision Nacional de Energia Atomica, Buenos Aires (Argentina)); Testoni, J. International Atomic Energy Agency, Vienna (Austria). Apr 1992. In *Research reactor core conversion guidebook. V. 3: Analytical verification (Appendices G and H).* 368p. Order Number DE93607812. Source: OSTI; NTIS (US Sales Only); INIS.

In Part 2 the calculational methods, described in Part 1, are applied in calculating the reactivity worth of Cd control rods in the RA-3 highly enriched uranium core and both Cd and Ag-In-Cd control rods in a proposed low enriched uranium core for the RA-3. The Ag-In-Cd rods are shown to have a higher reactivity worth than the Cd rods in the proposed low enriched uranium core. 2 refs, 1 fig., 2 tabs.

3219 (IAEA-TECDOC–643(v.3), pp. 361-368) **Measurements and analysis of critical experiments in the 'La Reina' reactor**

using medium enrichment uranium fuel. Klein, J. (Comision Chilena de Energia Nuclear, Santiago (Chile)); Venegas, R.; Mutis, O. International Atomic Energy Agency, Vienna (Austria). Apr 1992. In *Research reactor core conversion guidebook. V. 3: Analytical verification (Appendices G and H).* 368p. Order Number DE93607812. Source: OSTI; NTIS (US Sales Only); INIS.

The 5 MW La Reina reactor became critical on January 23, 1985 with 20 medium enrichment uranium fuel elements. Experiments were carried out to measure the change in critical core configuration characteristics between the previous highly enriched uranium fuel and the new medium enriched uranium fuel. This paper provides the results of measurements concerning with the critical approach, the axial flux distribution, and reflector savings and the excess reactivity, including results of neutronic calculations made for the critical experiments. (author). 7 refs, 5 figs, 1 tab.

3220 (IAEA-TECDOC–643(v.4)) **Research reactor core conversion guidebook. V. 4: Fuels (Appendices I-K).** International Atomic Energy Agency, Vienna (Austria). Apr 1992. 594p. Order Number DE93607813. Source: OSTI; NTIS (US Sales Only); INIS.

Volume 4 consists of detailed Appendices I-K, which contain useful information on the properties, irradiation testing, and specifications and inspection procedures for fuels with reduced uranium enrichments. Summaries of these appendices can be found in Chapters 9-11 of Volume 1 of this guidebook. Refs, figs, tabs and samples.

3221 (IAEA-TECDOC–643(v.4), pp. 31-39) **Phases in U-Si alloys.** Domagala, R.F. (Argonne National Lab., IL (United States)). International Atomic Energy Agency, Vienna (Austria). Apr 1992. Contract W-31-109-Eng-38. In *Research reactor core conversion guidebook. V. 4: Fuels (Appendices I-K).* 594p. Order Number DE93607813. Source: OSTI; NTIS (US Sales Only); INIS.

The binary (two-component) U-Si system contains a total of seven "compounds". The most U-rich compounds are of interest to the RERTR community because they are now being employed as fuels in research and test reactors. The nomenclature used in describing these fuels and the metallurgical significance of the notations recorded may have different meanings to people from different technical backgrounds. This paper is a succinct exploration of the principles of phase equilibria and the realities of commercial fabrication as applied to U-Si alloys. It is an attempt to record in referenceable and retrievable form information of value to the continued development, application and understanding of silicide fuels. (author). 5 refs, 4 figs, 1 tab.

3222 (IAEA-TECDOC–643(v.4), pp. 41-44) **Description and qualification of some aluminum alloys used by CERCA as cladding materials.** International Atomic Energy Agency, Vienna (Austria); Compagnie pour l'Etude et la Realisation de Combustibles Atomiques (CERCA), 26 - Romans-sur-Isere (France). Apr 1992. In *Research reactor core conversion guidebook. V. 4: Fuels (Appendices I-K).* 594p. Order Number DE93607813. Source: OSTI; NTIS (US Sales Only); INIS.

The specifications, physical and mechanical properties, and qualification of some of the aluminum alloys used by CERCA as cladding materials for MTR fuel elements are described. (author).

3223 (IAEA-TECDOC–643(v.4), pp. 45-46) **NUKEM cladding and structural materials.** International Atomic Energy Agency, Vienna (Austria); Nuklear-Chemie und -Metallurgie GmbH (NUKEM), Hanau (Germany). Apr 1992. In *Research reactor core conversion guidebook. V. 4: Fuels (Appendices I-K).* 594p. Order Number DE93607813. Source: OSTI; NTIS (US Sales Only); INIS.

The composition and maximum content of some of the aluminum alloys used by NUKEM as cladding and structural materials for MTR fuel elements are described. (author).

3224 (IAEA-TECDOC–643(v.4), pp. 49-52) **Water corrosion of aluminum alloy claddings.** International Atomic Energy Agency, Vienna (Austria); Argonne National Lab., IL (United States). Apr 1992. In *Research reactor core conversion guidebook. V. 4: Fuels (Appendices I-K).* 594p. Order Number DE93607813. Source: OSTI; NTIS (US Sales Only); INIS.

Literature applicable to the water corrosion of aluminum alloy claddings in research reactors is reviewed for the purposes of specifying operating parameters and estimating reasonable service lifetimes. (author). 13 refs, 2 figs.

3225 (IAEA-TECDOC–643(v.4), pp. 53-56) **Point corrosion defects of FRG-2 fuel elements.** Krull, W. (GKSS-Forschungszentrum Geesthacht GmbH, Geesthacht-Tesperhude (Germany)). International Atomic Energy Agency, Vienna (Austria). Apr 1992. In *Research reactor core conversion guidebook. V. 4: Fuels (Appendices I-K).* 594p. Order Number DE93607813. Source: OSTI; NTIS (US Sales Only); INIS.

Experience with point corrosion defects of FRG-2 fuel elements is described along with the measures that were taken to overcome point corrosion problems. (author). 9 refs, 3 figs.

3226 (IAEA-TECDOC–643(v.4), pp. 57-58) **Note on UK experience relating to corrosion of MTR fuel.** Panter, R. (UKAEA Harwell Lab. (United Kingdom)). International Atomic Energy Agency, Vienna (Austria). Apr 1992. In *Research reactor core conversion guidebook. V. 4: Fuels (Appendices I-K).* 594p. Order Number DE93607813. Source: OSTI; NTIS (US Sales Only); INIS.

Experience in the U.K. related to corrosion of MTR fuel elements clad in pure aluminum is described. Recommended conditions for demineralized water are provided along with the surface treatment used to passivate complete Harwell fuel elements. (author).

3227 (IAEA-TECDOC–643(v.4), pp. 59-60) **Aluminium corrosion data.** Baglin, C. (GEC Energy Systems Ltd., Leicester (United Kingdom)). International Atomic Energy Agency, Vienna (Austria). Apr 1992. In *Research reactor core conversion guidebook. V. 4: Fuels (Appendices I-K).* 594p. Order Number DE93607813. Source: OSTI; NTIS (US Sales Only); INIS.

Literature related to pitting corrosion of the aluminium used in the cladding of research reactor fuel elements is reviewed. Key data and conclusions are summarized. (author). 17 refs.

3228 (IAEA-TECDOC–643(v.4), pp. 61-67) **CRNL experience with aluminum cladding corrosion.** Graham, R.D. (Atomic Energy of Canada Ltd., Chalk River, ON (Canada). Chalk River Nuclear Labs.). International Atomic Energy Agency, Vienna (Austria). Apr 1992. In *Research reactor core conversion guidebook. V. 4: Fuels (Appendices I-K).* 594p. Order Number DE93607813. Source: OSTI; NTIS (US Sales Only); INIS.

CRNL experience with corrosion of the aluminum fuel cladding used in the NRU and NRX research reactors is described. Both reactors currently use HEU (93%) uranium-aluminum alloy rod-type fuel. NRU has had no problems with corrosion of the aluminum fuel cladding. NRX, which uses single pass, untreated water for fuel cooling and for which the fuel residence time is much longer than NRU, has generally had good performance from aluminum cladding. However, from 1975 to 1979, NRX had considerable trouble with cladding corrosion. That problems appears to have been resolved. (author). 2 figs, 4 tabs.

3229 (IAEA-TECDOC–643(v.4), pp. 69-77) **Water and corrosion technology of light water research reactors.** Pieper, H. (Forschungszentrum Juelich GmbH (Germany)). International Atomic Energy Agency, Vienna (Austria). Apr 1992. In *Research reactor core conversion guidebook. V. 4: Fuels (Appendices I-K).* 594p. Order Number DE93607813. Source: OSTI; NTIS (US Sales Only); INIS.

Light water is used as primary coolant and as moderator in most of the research reactors. In order to keep the corrosion of the structural materials used in the reactor as small as possible, specific requirements must be fulfilled both with respect to the water quality and also the engineering design of the system. The values which are associated with the fulfillment of these objectives may be termed "chemical parameters". Suitable measures will be discussed which influence these chemical parameters and which satisfactorily fulfill the requirement to be met by water chemistry. In addition, experience gained in operating the Juelich FRJ-1 reactor will be demonstrated. (author). 2 tabs.

3230 (IAEA-TECDOC–643(v.4), pp. 79-88) **Exothermic reactions in U_3O_8 dispersion fuel.** International Atomic Energy Agency, Vienna (Austria); Argonne National Lab., IL (United States); Oak Ridge National Lab., TN (United States). Apr 1992. In

Research reactor core conversion guidebook. V. 4: Fuels (Appendices I-K). 594p. Order Number DE93607813. Source: OSTI; NTIS (US Sales Only); INIS.

A summary is provided of the experiments conducted since 1963 to study exothermic reactions in the U_3O_8-Al system. (author). 13 refs, 5 figs, 3 tabs.

3231 (IAEA-TECDOC–643(v.4), pp. 89-106) **A differential thermal analysis study of U_3Si-Al and U_3Si_2-Al reactions.** Domagala, R.F. (Argonne National Lab., IL (United States)); Wiencek, T.C.; Snelgrove, J.L.; Homa, M.I.; Heinrich, R.R. International Atomic Energy Agency, Vienna (Austria). Apr 1992. In *Research reactor core conversion guidebook. V. 4: Fuels (Appendices I-K).* 594p. Order Number DE93607813. Source: OSTI; NTIS (US Sales Only); INIS.

As part of the Reduced Enrichment Research and Test Reactor (RERTR) Program, high density uranium compounds are being evaluated as possible replacements for the fuels currently in use. U_3Si and U_3Si_2 powders dispersed in an Al matrix and roll bonded within 6061 Al alloy clad have performed well under irradiation in the ORR. A consideration of the heats of reaction between the silicides and the Al components of a reactor fuel plate has now been addressed. By following standard quantitative differential thermal analysis (DTA) procedures, it has been demonstrated that neither silicide shows any measurable heat of reaction until the solidus temperature of 6061 (582 deg. C) is exceeded. On heating, the exothermic reaction is quenched by the endothermic change of state as the Al species melt. All detectable events take place in the temperature regime ≈580 to ≈660 deg. C. The heats of reaction per gram of fuel ranged from 304 ± 18 J for samples with 32 vol.% U_3Si_2 in the fuel zone to 486 ± 54 J for samples containing 45 vol.% U_3Si in the fuel zone. (author). 6 refs, 11 figs, 7 tabs.

3232 (IAEA-TECDOC–643(v.4), pp. 13-29) **Selected thermal properties and uranium density relations for alloy, aluminide, oxide, and silicide fuels.** Matos, J.E. (Argonne National Lab., IL (United States)); Snelgrove, J.L. International Atomic Energy Agency, Vienna (Austria). Apr 1992. In *Research reactor core conversion guidebook. V. 4: Fuels (Appendices I-K).* 594p. Order Number DE93607813. Source: OSTI; NTIS (US Sales Only); INIS.

This appendix presents data on the specific heat, thermal conductivity, and other properties of fuel meat materials commonly used, or considered for use, in research and test reactors. Also included are formulae relating the density of uranium in the fuel meat with the weight fraction of uranium and the volume fraction of the dispersed phase. (author). 23 refs, 8 figs, 5 tabs.

3233 (IAEA-TECDOC–643(v.4), pp. 107-113) **Reaction behaviour of U_xSi_y-Al and U_6Fe-Al dispersions.** Nazare, S. (Kernforschungszentrum Karlsruhe GmbH (Germany). Inst. fuer Material- und Festkoerperforschung). International Atomic Energy Agency, Vienna (Austria). Apr 1992. In *Research reactor core conversion guidebook. V. 4: Fuels (Appendices I-K).* 594p. Order Number DE93607813. Source: OSTI; NTIS (US Sales Only); INIS.

The paper describes the experiments carried out using differential thermal analysis (DTA) to investigate the reactions in fuel plates with U_3Si-, U_3Si_2- and U_6Fe-Al dispersions up to and beyond clad melting. In all cases, exothermic reactions are observed at about 630 deg. C. In the case of the silicides, UAl_3 with silicon in solution is the main reaction product; in the case of U_6Fe, UAl_4 is the main reaction product. The enthalpies of reaction were determined after calibration with suitable standards. The values obtained reveal the largest energy release in the case of the U_6Fe-Al dispersions. Reactions in the U_3Si_2-Al system are less exothermic than in the U_3Si-Al system. (author). 6 refs, 7 figs.

3234 (IAEA-TECDOC–643(v.4), pp. 115-121) **Differential thermal analysis and metallographic examinations of U_3Si_2 powder and U_3Si_2/Al (38 w/o) miniplates.** Toft, P. (Atlas-Danmark A/S (Denmark). Advanced Engineering Div.); Jensen, A. International Atomic Energy Agency, Vienna (Austria). Apr 1992. In *Research reactor core conversion guidebook. V. 4: Fuels (Appendices I-K).* 594p. Order Number DE93607813. Source: OSTI; NTIS (US Sales Only); INIS.

The paper describes the thermodynamic and metallurgical behavior of U_3Si_2 powder and miniplates with regard to the following aspects: increasing temperatures up to 1400 deg. C; fuel plate stability; formation of ternary intermetallic compounds; growth of the formed ternary intermetallic crystals at increasing temperatures. The miniplate core is U_3Si_2/Al(38w/o) and the cladding is Al 6061. The study concludes, that fuel plates will not remain stable under accident conditions. A fuel element will most likely melt down before a stable structure is established. The work is performed under contract with RISO National Laboratories, Denmark. (author). 9 samples.

3235 (IAEA-TECDOC–643(v.4), pp. 123-132) **Structural stability of plate-type fuel elements used in US research and test reactors.** International Atomic Energy Agency, Vienna (Austria); Argonne National Lab., IL (United States). Apr 1992. In *Research reactor core conversion guidebook. V. 4: Fuels (Appendices I-K).* 594p. Order Number DE93607813. Source: OSTI; NTIS (US Sales Only); INIS.

Information is presented on the methods that have been used to design fuel elements for several research and test reactors in the U.S. The emphasis is on the methods of analysis and the tests used to ensure stability of the fuel elements under normal operating conditions of full flow and design power. (author). 14 refs, 1 fig., 1 tab.

3236 (IAEA-TECDOC–643(v.4), pp. 133-141) **Hydraulic tests on dummy fuel elements for JAERI reactors.** Sato, T. (Japan Atomic Energy Research Inst., Tokai, Ibaraki (Japan). JRR-2 Section); Simizu, K.; Kurosawa, K. International Atomic Energy Agency, Vienna (Austria). Apr 1992. In *Research reactor core conversion guidebook. V. 4: Fuels (Appendices I-K).* 594p. Order Number DE93607813. Source: OSTI; NTIS (US Sales Only); INIS.

For the JRR-2 reactor and the JMTR reactor, dummy fuel elements using depleted uranium were fabricated and hydraulic tests were carried out for two purposes. One purpose was to confirm fabrication techniques and inspection methods in order to establish reasonable specifications for succeeding MEU fuel elements. The other purpose was to confirm the integrity of the fuel elements under normal and abnormal hydraulic conditions. (author). 8 figs.

3237 (IAEA-TECDOC–643(v.4), pp. 161-185) **Uranium-zirconium hydride TRIGA-LEU fuel.** International Atomic Energy Agency, Vienna (Austria); General Atomics, San Diego, CA (United States). Apr 1992. In *Research reactor core conversion guidebook. V. 4: Fuels (Appendices I-K).* 594p. Order Number DE93607813. Source: OSTI; NTIS (US Sales Only); INIS.

The development and testing of TRIGA-LEU fuel with up to 45 wt-% U is described. Topics that are discussed include properties of hydride fuels, the prompt negative temperature coefficient, pulse heating tests, fission product retention, and the limiting design basis parameter and values. General specifications for Er-U-ZrH TRIGA-LEU fuel with 8.5 to 45 wt-% U and an outline of the inspections during manufacture of the fuel are also included. (author). 8 figs, 1 tab.

3238 (IAEA-TECDOC–643(v.4), pp. 187-194) **Final results from TRIGA LEU fuel post-irradiation examination and evaluation following long term irradiation testing in the ORR.** West, G.B. (General Atomics, San Diego, CA (United States)); Simnad, M.T.; Copeland, G.L. International Atomic Energy Agency, Vienna (Austria). Apr 1992. In *Research reactor core conversion guidebook. V. 4: Fuels (Appendices I-K).* 594p. Order Number DE93607813. Source: OSTI; NTIS (US Sales Only); INIS.

The qualification testing of TRIGA-LEU (U-ZrH) fuels to high burnups in the ORR has been completed successfully over a 5-yr period. These fuels have included loadings of 20 wt %, 30 wt %, and 45 wt % uranium; 19.7% enriched. The irradiated fuel rods have been subjected to a comprehensive PIE following burnups of up to 64% of the U-235, exposures of 919 FPD and fast neutron fluences of $5x10^{21}$ n/cm^2. No limiting values were reached on fuel burnup. Fuel growth was as predicted. Evidence was shown of limited thermal migration of hydrogen. There was no pressure buildup inside the cladding. Fission product release from highly burned fuel doesn't appear to be significantly different from fresh fuel. The results have demonstrated that these fuels will retain their integrity to burnups well in excess of the design goals. (author). 5 figs, 3 tabs.

3239 (IAEA-TECDOC–643(v.4), pp. 197-204) **PIE data for HEU (93%) aluminide and oxide fuels.** International Atomic Energy Agency, Vienna (Austria); Argonne National Lab., IL (United States). Apr 1992. In *Research reactor core conversion guidebook. V. 4: Fuels (Appendices I-K).* 594p. Order Number DE93607813. Source: OSTI; NTIS (US Sales Only); INIS.

Post-irradiation-examination data are summarized for HEU (93%) UAl_x-Al dispersion fuel with up to 1.7 g U/cm^3 and for HEU (93%) U_3O_8-Al dispersion fuel with up to 1.2 g U/cm^3. (author). 14 refs, 6 figs, 2 tabs.

3240 (IAEA-TECDOC–643(v.4), pp. 143-159) **'Caramel' - French LEU fuel for research reactors with emphasis on the OSIRIS experience of core conversion.** International Atomic Energy Agency, Vienna (Austria); CEA Centre d'Etudes de Saclay, 91 - Gif-sur-Yvette (France). Apr 1992. In *Research reactor core conversion guidebook. V. 4: Fuels (Appendices I-K).* 594p. Order Number DE93607813. Source: OSTI; NTIS (US Sales Only); INIS.

Key aspects of the design, development, and qualification of French LEU "Caramel" fuel are discussed. These aspects include descriptions of the fabrication steps, the quality control procedures that are employed in fuel fabrication, and the extensive qualification program to determine first the technological limits and then the safe and reliable operating ranges for this type of fuel. Experience in utilizing "Caramel" fuel in the high performance OSIRIS reactor is emphasized. Necessary adaptations of the plant primary cooling circuit are described along with operating experience, changes in the experimental conditions, and possible application in other research reactors. (author). 4 figs.

3241 (IAEA-TECDOC–643(v.4), pp. 205-216) **A statistical evaluation of the irradiation performance of HEU-based UAl_x-Al dispersion fuels.** Gahlert, S. (Kernforschungszentrum Karlsruhe GmbH (Germany)); Nazare, S. International Atomic Energy Agency, Vienna (Austria). Apr 1992. In *Research reactor core conversion guidebook. V. 4: Fuels (Appendices I-K).* 594p. Order Number DE93607813. Source: OSTI; NTIS (US Sales Only); INIS.

A large body of data was generated during the development and testing of HEU (93%) UAl_x-Al fuel with U-densities up to 1.7 Mg U/m^3. The data reveals a large scatter which can be expected not only from the parameter variation (metallurgical and testing) but also from the difficulties encountered in post-irradiation examinations. This paper provides a statistical evaluation of the influence of various parameters such as fission density, burnup, fuel loading, boron content, and irradiation temperature on the two major performance criteria - namely swelling and blistering, and develops empirical equations capable of predicting the swelling and blistering behavior. (author). 14 refs, 4 figs, 4 tabs.

3242 (IAEA-TECDOC–643(v.4), pp. 217-228) **Irradiation experiments.** International Atomic Energy Agency, Vienna (Austria); CEA Centre d'Etudes de Saclay, 91 - Gif-sur-Yvette (France). Apr 1992. In *Research reactor core conversion guidebook. V. 4: Fuels (Appendices I-K).* 594p. Order Number DE93607813. Source: OSTI; NTIS (US Sales Only); INIS.

Irradiation experiments conducted in 1972-1973 in the OSIRIS reactor on fuel plates containing 93% enriched uranium are described. Eight plates contained UAl_3-Al fuel with 35 wt% U (1.3 g U/cm^3) and 43 wt% U (1.7 g U/cm^3) and two plates contained U_3O_8-Al fuel with 43 wt% U (1.7 g U/cm^3). The average burnup of the ^{235}U was 58.5% and the maximum burnup was 70%. Results of the post-irradiation-examinations include data on dimensional measurements and metallographic examinations, the influence of grain size and the percentage of fines below 40 microns in the UAl_3-Al plates with 35 wt% U, and the minimum temperature at which swelling appears with the occurrence of blisters after post-irradiation annealing. All of the tested plates behaved satisfactorily under irradiation. (author). 2 refs, 3 figs, 4 tabs.

3243 (IAEA-TECDOC–643(v.4), pp. 229-230) **Reliability of LEU fuel.** Krull, W. (GKSS-Forschungszentrum Geesthacht GmbH, Geesthacht-Tesperhude (Germany)). International Atomic Energy Agency, Vienna (Austria). Apr 1992. In *Research reactor core conversion guidebook. V. 4: Fuels (Appendices I-K).* 594p. Order Number DE93607813. Source: OSTI; NTIS (US Sales Only); INIS.

Requirements on the reliability of LEU fuel are summarized from the point of view of a German reactor operator and his independent experts. (author). 1 ref.

3244 (IAEA-TECDOC–643(v.4), pp. 231-236) **Post-irradiation examinations of dispersion fuels with reduced enrichment.** Snelgrove, J.L. (Argonne National Lab., IL (United States)). International Atomic Energy Agency, Vienna (Austria). Apr 1992. In *Research reactor core conversion guidebook. V. 4: Fuels (Appendices I-K).* 594p. Order Number DE93607813. Source: OSTI; NTIS (US Sales Only); INIS.

This appendix outlines the philosophy and procedures that were utilized by the U.S. RERTR Program for non-destructive and destructive post-irradiation examination of miniplates and full-size elements utilizing low enriched (<20%) uranium fuels with high uranium densities. (author).

3245 (IAEA-TECDOC–643(v.4), pp. 239-267) **Miniplate irradiations in the Oak Ridge Research Reactor.** International Atomic Energy Agency, Vienna (Austria); Oak Ridge National Lab., TN (United States); Argonne National Lab., IL (United States). Apr 1992. In *Research reactor core conversion guidebook. V. 4: Fuels (Appendices I-K).* 594p. Order Number DE93607813. Source: OSTI; NTIS (US Sales Only); INIS.

The miniplate irradiation program was designed to screen a large number of possible LEU fuel types for use in research and test reactors. Two hundred and forty-four miniplates fabricated by ANL, CNEA, EG and G Idaho, NUKEM, and ORNL were irradiated in the Oak Ridge Research Reactor (ORR). Eleven types of fuel were tested: U_3Si_2, $U_3Si_{1.5}$, U_3Si, USi, U_3SiCu, U_3SiAl, U_3O_8, UAl_x, UAl_2, U_6Fe, and $U_6Mn_{1.3}$. The samples included a wide range (0.2%-93%) of enrichments and uranium densities up to 8 Mg/m^3. Most of the miniplates were irradiated beyond the 50% burnup level that is typical for research reactor fuel. Some were irradiated beyond 90% burnup of the contained ^{235}U. Extensive post-irradiation-examinations were performed. These examinations included measurement of swelling, blister threshold temperatures, fission product release temperatures, and metallurgical analyses. (author). 37 refs, 11 figs, 4 tabs.

3246 (IAEA-TECDOC–643(v.4), pp. 269-270) **Full-sized element irradiations in the Oak Ridge Research Reactor.** International Atomic Energy Agency, Vienna (Austria); Oak Ridge National Lab., TN (United States); Argonne National Lab., IL (United States). Apr 1992. In *Research reactor core conversion guidebook. V. 4: Fuels (Appendices I-K).* 594p. Order Number DE93607813. Source: OSTI; NTIS (US Sales Only); INIS.

Twenty-one full-size test elements were irradiated in the ORR between 1981 and 1985 as part of the RERTR Program. The purpose of these irradiations was to confirm that the data obtained from the miniplate irradiations was applicable to complete elements. Table 1 lists the key characteristics of these elements: element number, fuel type, enrichment, initial uranium density and fissile loading, percentage ^{235}U depletion, and the date at which each irradiation was completed. This appendix consists of three papers that provide the main results of the irradiations and post-irradiation examinations. (author). 1 tab.

3247 (IAEA-TECDOC–643(v.4), pp. 271-282) **Irradiation performance of low-enriched uranium fuel elements.** Copeland, G.L. (Oak Ridge National Lab., TN (United States)); Hofman, G.L.; Snelgrove, J.L. International Atomic Energy Agency, Vienna (Austria). Apr 1992. Contract DE-AC05-85OR21400;Contract W-31-109-Eng-38. In *Research reactor core conversion guidebook. V. 4: Fuels (Appendices I-K).* 594p. Order Number DE93607813. Source: OSTI; NTIS (US Sales Only); INIS.

The status of the testing and evaluation of full-sized experimental low-and medium-enriched uranium fuel elements in the Oak Ridge Research Reactor is presented. Medium-enriched elements containing oxide and aluminide have been completely evaluated at burnups up to 75%. A low-enriched U_3Si_2 element has been evaluated at 41% burnup. Other silicide and oxide elements have completed irradiation satisfactorily to burnups of 75% and are now being evaluated. All results to date confirm the expected good performance of these elements in the medium power research reactor environment. (author). 5 refs, 6 figs, 2 tabs.

3248 (IAEA-TECDOC–643(v.4), pp. 283-301) **Performance of low-enriched uranium aluminide-aluminum thick-plate fuel elements in the Oak Ridge Research Reactor.** Copeland, G.L. (Oak Ridge National Lab., TN (United States)); Snelgrove, J.L. International Atomic Energy Agency, Vienna (Austria). Apr 1992. In *Research reactor core conversion guidebook. V. 4: Fuels (Appendices I-K).* 594p. Order Number DE93607813. Source: OSTI; NTIS (US Sales Only); INIS.

Two high-density, low-enriched, thick-plate UAl_x-Al dispersion fuel elements, fabricated by CERCA, have been tested in the Oak Ridge Research Reactor (ORR). The fuel meat was nominally 1.5 mm thick, and the uranium density in the fuel meat was 2.1 Mg/m^3 in one element and 2.3 Mg/m^3 in the other. The elements were irradiated in several core positions. The lower-density element was irradiated to approximately normal ORR burnup (50 to 56% ^{235}U depletion), and the higher-density element was irradiated to an average burnup of 72%, well above the burnups normally achieved in research and test reactors. Peak burnups over 97% were achieved. Following suitable cooling periods, the elements were subjected to a series of nondestructive and destructive (higher-density element only) examinations, including visual inspection and dimensional measurements, channel gap thickness measurements, gamma scans, plate thickness measurements, blister threshold temperature tests, metallography, and isotopic burnup analyses. Externally, the elements were essentially unchanged from their as-fabricated condition. The behavior of the fuel was found to be entirely consistent with that expected on the basis of results of previous tests using miniature fuel plates. The plates showed small, uniform thickness changes, ranging up to 100 μm in regions of ≈97% burnup. No blisters formed over the fuel meat during postirradiation anneals, even at 575 deg. C. It is concluded that high-density low-enriched UAl_x-Al dispersion fuel elements with fuel meat thicknesses up to 1.5 mm will perform at least as well in research and test reactors with up to medium power density as the high-enriched UAl_x-Al dispersion fuel elements currently being used in many reactors. (author). 10 refs, 10 figs, 6 tabs.

3249 (IAEA-TECDOC–643(v.4), pp. 303-313) **Examination of U_3Si_2-Al fuel elements from the Oak Ridge Research Reactor.** Copeland, G.L. (Oak Ridge National Lab., TN (United States)); Hofman, G.L.; Snelgrove, J.L. International Atomic Energy Agency, Vienna (Austria). Apr 1992. In *Research reactor core conversion guidebook. V. 4: Fuels (Appendices I-K).* 594p. Order Number DE93607813. Source: OSTI; NTIS (US Sales Only); INIS.

The results of postirradiation examination of low-enriched U_3Si_2 fuel elements from the Oak Ridge Research Reactor are presented. The elements replaced standard highly-enriched elements and were handled routinely except that the burnup of three of the elements was extended beyond normal limits -up to about 98% peak. The elements were manufactured by commercial fuel suppliers. The performance of all elements was completely satisfactory. (author). 4 refs, 6 figs, 2 tabs.

3250 (IAEA-TECDOC–643(v.4), pp. 315-327) **LEU and MEU fuel testing in CEA reactors.** Baas, C. (CEA Centre d'Etudes de Grenoble, 38 (France)); Martel, P.; Merchie, F.; Barnier, M.; Beylot, J.P. International Atomic Energy Agency, Vienna (Austria). Apr 1992. In *Research reactor core conversion guidebook. V. 4: Fuels (Appendices I-K).* 594p. Order Number DE93607813. Source: OSTI; NTIS (US Sales Only); INIS.

The progress achieved in the qualification of LEU and MEU fuels in the SILOE reactor and LEU fuel in the OSIRIS reactor is presented. This program, which began in the SILOE reactor in 1980 involves irradiation of a complete UAl element with 45% enriched uranium and 2.2 g U/cm^3, full-sized plates with LEU U_3Si and U_3Si_2 fuels, and complete elements with LEU loadings of 6.0 g U/cm^3 with U_3Si and 5.2 g U/cm^3 with U_3Si_2. Periodical examinations were carried out during irradiation, in particular plate thickness and water channel width measurements. Finally, the characteristics and status of a mixed U_3Si-U_3Si_2 element under irradiation in the OSIRIS reactor is presented. (author). 7 refs, 10 figs, 2 tabs.

3251 (IAEA-TECDOC–643(v.4), pp. 329-365) **Final report on the irradiation testing and post-irradiation examination of low enriched U_3O_8-Al and UAl_x-Al fuel elements by the Netherlands Energy Research Foundation (ECN).** Pruiboom, H. (Netherlands Energy Research Foundation (ECN), Petten (Netherlands)); Lijbrijk, E.; Otterdijk, K.H. van; Swanenburg, R.J. de Veye. International Atomic Energy Agency, Vienna (Austria). Apr 1992. In *Research reactor core conversion guidebook. V. 4: Fuels (Appendices I-K).* 594p. Order Number DE93607813. Source: OSTI; NTIS (US Sales Only); INIS.

Within the framework of the RERTR-programme four low-enriched (20%) MTR-type fuel elements have been irradiated in the High Flux Reactor at Petten (The Netherlands) and subjected to post-irradiation examination. Two of the elements contain UAl_x-Al and two contain U_3O_8-Al fuel. The test irradiation has been completed up to the target burn-up values of 50% and 75% respectively. An extensive surveillance programme carried out during the test period has confirmed the excellent in-reactor behaviour of both types. Post-irradiation examination of the test elements, comprising of dimensional measurements, burn-up determination, fuel metallography and blister testing, has confirmed the irradiation experiences. Good agreement between calculated and measured power and burn-up characteristics has been found. A survey of the test element characteristics, their irradiation history, the irradiation tests and the PIE results is given in this report. (author). 5 refs, 31 figs, 3 tabs.

3252 (IAEA-TECDOC–643(v.4), pp. 367-368) **Full size element irradiations in the FRG-2.** Krull, W. (GKSS-Forschungszentrum Geesthacht GmbH, Geesthacht-Tesperhude (Germany)). International Atomic Energy Agency, Vienna (Austria). Apr 1992. In *Research reactor core conversion guidebook. V. 4: Fuels (Appendices I-K).* 594p. Order Number DE93607813. Source: OSTI; NTIS (US Sales Only); INIS.

Irradiation and post-irradiation-examination in the FRG-2 reactor of 5 test plates with LEU U_3Si_2 fuel and 21 full size elements with MEU $UA1_x$ fuel, LEU U_3O_8 fuel, and LEU U_3Si_2 fuel are summarized. All test plates and fuel elements were irradiated to greater than 60% average burnup of the contained ^{235}U. (author). 1 tab.

3253 (IAEA-TECDOC–643(v.4), pp. 369-380) **The conversion of NRU from HEU to LEU fuel.** Sears, D.F. (Atomic Energy of Canada Ltd., Chalk River, ON (Canada). Chalk River Nuclear Labs.); Atfield, M.D.; Kennedy, I.C. International Atomic Energy Agency, Vienna (Austria). Apr 1992. In *Research reactor core conversion guidebook. V. 4: Fuels (Appendices I-K).* 594p. Order Number DE93607813. Source: OSTI; NTIS (US Sales Only); INIS.

The program at Chalk River Nuclear Laboratories (CRNL) to develop and test low-enriched uranium fuel (LEU, <20% U-235) is reviewed, and the status of the conversion of the NRU reactor from highly enriched uranium (HEU, 93% U-235) to LEU fuel is discussed. The replacement LEU fuels developed and tested at CRNL contain high-density uranium silicide particles dispersed in aluminum, in cylindrical rods. The silicides tested include U_3Si, USiAl, USi*Al and U_3Si_2 (U-3.96 wt% Si; U-3.5 wt% Si-1.5 wt% Al, U-3.2 wt% Si-3 wt% Al; U-7.3 wt% Si, respectively). Fuel elements were fabricated with uranium loadings suitable for NRU, 3.15 gU/cm^3, and for NRX, 4.5 gU/cm^3, and were irradiated under normal fuel-operating conditions. Eight experimental irradiations involving 100 mini-elements and 84 full-length elements (7x12-element rods) were completed to qualify the LEU fuel and the fabrication technology. Post-irradiation examinations confirmed that the performance of the LEU fuel, and that of a medium-enrichment uranium (MEU, 45% U-235) alloy fuel tested as a back-up, was comparable to the HEU fuel. The uranium silicide dispersion fuel swelling was approximately linear up to burnups exceeding NRU's design terminal burnup (80 at%)/NRU was partially converted to LEU fuel when the first 31 prototype fuel rods manufactured with the production equipment were installed in the reactor. The rods were loaded in NRU at a fueling rate of about two rods per week over the period 1988 September to December. This partial LEU core (one third of a full NRU core) has allowed the reactor engineers and physicists to evaluate the bulk effects of the LEU conversion on NRU operations. As expected, the irradiation is proceeding without incident. (author). 4 refs, 4 figs, 2 tabs.

3254 (IAEA-TECDOC–643(v.4), pp. 381-384) **Development of low enrichment MTR fuel at Dounreay.** Sinclair, D. (UKAEA Dounreay Nuclear Power Development Establishment (United Kingdom)). International Atomic Energy Agency, Vienna (Austria).

Apr 1992. In *Research reactor core conversion guidebook. V. 4: Fuels (Appendices I-K).* 594p. Order Number DE93607813. Source: OSTI; NTIS (US Sales Only); INIS.

Work up to October 1983 on the development of a manufacturing route for the manufacture of low enriched fuel at Dounreay concentrated on the roll-bonding method of plate manufacture. Both U-Al alloy and U_3O_8-Al cermet elements at 45% enrichment have been irradiated and the fabrication of 20% enriched U_3O_8-Al cermet elements is in hand. (author). 3 refs, 2 tabs.

3255 (IAEA-TECDOC–643(v.4), pp. 385-395) **Irradiation of MEU and LEU test fuel elements in DR 3.** Haack, K. (Risoe National Lab., Roskilde (Denmark)). International Atomic Energy Agency, Vienna (Austria). Apr 1992. In *Research reactor core conversion guidebook. V. 4: Fuels (Appendices I-K).* 594p. Order Number DE93607813. Source: OSTI; NTIS (US Sales Only); INIS.

Irradiation of three MEU and three LEU fuel elements in the Danish reactor DR 3. Thermal and fast neutron flux density scans of the core have been made and the results, related to the U235-content of each fuel element, are compared with the values from HEU fuel elements. The test elements were taken to burn-up percentages of 50-60%. Reactivity values of the test elements at charge and at discharge have been measured and the values are compared with those of HEU fuel elements. (author). 5 refs, 4 figs, 3 tabs.

3256 (IAEA-TECDOC–643(v.4), pp. 397-411) **Irradiation in DR 3 of three Danish manufactured LEU silicide test fuel elements.** International Atomic Energy Agency, Vienna (Austria); Risoe National Lab., Roskilde (Denmark). Apr 1992. In *Research reactor core conversion guidebook. V. 4: Fuels (Appendices I-K).* 594p. Order Number DE93607813. Source: OSTI; NTIS (US Sales Only); INIS.

The 3 test fuel elements of the U_3Si_2-Al type enriched to 19.75% with 180g ^{235}U was manufactured by ATLAS AED. The silicide powder was delivered by Babcock and Wilcox, USA. The elements were irradiated in DR 3 from August 1986 to April 1987 to burn-ups ranging from 51% to 57%. The elements performed perfect during the irradiation. The fuel tubes have been visually inspected for blisters and other irregularities after cutting in the pond. No defects were found. Later on thickness measurements of the fuel tube plates will be attempted and documentary photographing of the fuel tube surfaces will be undertaken. (author). 2 refs, 10 figs, 4 tabs.

3257 (IAEA-TECDOC–643(v.4), pp. 413-417) **Fission product release from alloy, aluminide, oxide, and silicide fuels.** Stahl, D. (Argonne National Lab., IL (United States)); Snelgrove, J.L. International Atomic Energy Agency, Vienna (Austria). Apr 1992. In *Research reactor core conversion guidebook. V. 4: Fuels (Appendices I-K).* 594p. Order Number DE93607813. Source: OSTI; NTIS (US Sales Only); INIS.

Information on the release of fission products from plate-type fuels is relatively scarce. Much of the early data is for uranium metal or UO_2 fuels; however, some data are available from the 1960s for uranium-aluminum alloy fuels and for UAl_x and U_3O_8 dispersion fuels. A renewed interest in plate-and tube-type fuels during the 1980s, partly as a consequence of the RERTR Program, has resulted in new fission product release measurements for U-Al alloy and UAl_x, U_3O_8, and uranium silicide dispersion fuels. As discussed in the following paragraphs, the out-of-pile data for all types of aluminum-based plate-type fuel shows a consistent pattern, namely that major release of fission gases begins when the aluminum cladding blisters or begins to melt. Once having reached the melting point, however, the release of the noble gases is essentially complete in heating the fuel another 100 deg. C. The volatile fission products are released more slowly as a function of temperature, and their release rates vary with fuel type. Available data from reactor accidents indicate that, in cases where water coolant is present in the core when fuel melts, only the noble gases are released in any quantity. The iodines and less volatile fission products are effectively retained by the water. 17 refs, 1 fig.

3258 (IAEA-TECDOC–643(v.4), pp. 419) **Release of fission products from irradiated aluminide fuel at high temperatures.** Shibata, T. (Kyoto Univ., Kumatori, Osaka (Japan). Research Reactor Inst.); Tamai, T.; Hayashi, M.; Posey, J.C.; Snelgrove, J.L. International Atomic Energy Agency, Vienna (Austria). Apr 1992. In *Research reactor core conversion guidebook. V. 4: Fuels (Appendices I-K).* 594p. Order Number DE93607813. Source: OSTI; NTIS (US Sales Only); INIS.

The full text of this paper was published in Nuclear Science and Engineering, 87, 405-417 (1984).

Irradiated uranium-aluminide fuel plates of 40% ^{235}U enrichment were heated for the determination of the amounts of fission products released at temperatures up to and higher than the melting point of the fuel cladding material. The release of fission products from the fuel plate at temperatures below 500 deg. C was negligible. Three stages of fission product releases were observed. The first rapid release was observed at ≈561 deg. C along with blistering of the plates. The next release, which occurred at 585 deg. C, might have been caused by melting of the Type 6061 aluminum alloy. The last release of fission product gases occurred at 650 deg. C, which probably corresponds to the eutectic temperature of the uranium-aluminum alloy. The released material was mostly xenon, and small amounts of iodine and cesium were observed. (author). Abstract only.

3259 (IAEA-TECDOC–643(v.4), pp. 421-431) **Release of fission products from miniature fuel plates at elevated temperature.** Posey, J.C. (Oak Ridge National Lab., TN (United States)). International Atomic Energy Agency, Vienna (Austria). Apr 1992. In *Research reactor core conversion guidebook. V. 4: Fuels (Appendices I-K).* 594p. Order Number DE93607813. Source: OSTI; NTIS (US Sales Only); INIS.

Three miniature fuel plates were tested at progressively higher temperatures. A U_3Si plated blistered and released fission gases at 500 deg. C. Two U_3O_8 filled plates blistered and released fission gases at 550 deg. C. (author). 1 ref., 7 figs, 8 tabs.

3260 (IAEA-TECDOC–643(v.4), pp. 433-441) **Further data of silicide fuel for the LEU conversion of JMTR.** Saito, M. (Japan Atomic Energy Research Inst., Oarai, Ibaraki (Japan). Oarai Research Establishment); Futamura, Y.; Nakata, H.; ANdo, H.; Sakurai, F.; Ooka, N.; Sakakura, A.; Ugajin, M.; Shirai, E. International Atomic Energy Agency, Vienna (Austria). Apr 1992. In *Research reactor core conversion guidebook. V. 4: Fuels (Appendices I-K).* 594p. Order Number DE93607813. Source: OSTI; NTIS (US Sales Only); INIS.

Data of silicide fuel for the safety assessment of the JMTR LEU fuel conversion are being measured. The data include release of fission products, thermal properties, behaviors under accident condition and metallurgical characters. Methods of the experiments are discussed. Results of fission products release at high temperature are described. The release of iodine from the silicide fuel is considerably lower than the U-Al alloy fuel. (author). 2 refs, 6 figs, 3 tabs.

3261 (IAEA-TECDOC–643(v.4), pp. 445-456) **Standardization of specifications and inspection procedures for LEU plate-type research reactor fuels.** Krull, W. (GKSS-Forschungszentrum Geesthacht GmbH, Geesthacht-Tesperhude (Germany)). International Atomic Energy Agency, Vienna (Austria). Apr 1992. In *Research reactor core conversion guidebook. V. 4: Fuels (Appendices I-K).* 594p. Order Number DE93607813. Source: OSTI; NTIS (US Sales Only); INIS.

The subject of standardization of specifications and inspection procedures has become important as one means of limiting fuel cost increases inherent with conversions to LEU plate-type research reactor fuels. An edited version of a draft report of an IAEA Consultant's Group is presented here. It is concluded that specifications should be carefully reviewed when changing from HEU to LEU fuel in order to avoid perpetuating overly restrictive requirements. Tentative recommendations are given for a number of specification topics. (author). 17 refs require.

3262 (IAEA-TECDOC–643(v.4), pp. 505-513) **Specifications.** International Atomic Energy Agency, Vienna (Austria); Risoe National Lab., Roskilde (Denmark). Apr 1992. In *Research reactor core conversion guidebook. V. 4: Fuels (Appendices I-K).* 594p. Order Number DE93607813. Source: OSTI; NTIS (US Sales Only); INIS.

As part of the Danish RERTR Program, three fuel elements with LEU U_3O_8-Al fuel and three fuel elements with LEU U_3Si_2-Al fuel were manufactured by NUKEM for irradiation testing in the DR-3

reactor at the Risoe National Laboratory in Denmark. The specifications for the elements with U_3O_8-Al fuel are presented here as an illustration only. Specifications for the elements with U_3Si_2-Al fuel were very similar. In this example, materials, material numbers, documents numbers, and drawing numbers specific to a single fabricator have been deleted. (author).

3263 (IAEA-TECDOC–643(v.4), pp. 515-551) **Inspection scheme.** International Atomic Energy Agency, Vienna (Austria); Risoe National Lab., Roskilde (Denmark). Apr 1992. In *Research reactor core conversion guidebook. V. 4: Fuels (Appendices I-K).* 594p. Order Number DE93607813. Source: OSTI; NTIS (US Sales Only); INIS.

As part of the Danish RERTR Program, three fuel elements with LEU U_3O_8-Al fuel and three fuel elements with LEU U_3Si_2-Al fuel were manufactured by NUKEM for irradiation testing in the DR-3 reactor at the Risoe National Laboratory in Denmark. The inspection scheme for the elements with U_3O_8-Al fuel is presented here as an illustration only. The inspection scheme for the elements with U_3Si_2-Al fuel was very similar. In this example, all document numbers, drawing numbers, and form numbers have been deleted or replaced with a generic identification. (author).

3264 (IAEA-TECDOC–643(v.4), pp. 553-562) **Specifications for fuel plates with LEU U_3Si_2-Al fuel for the Oak Ridge Research Reactor.** International Atomic Energy Agency, Vienna (Austria); Argonne National Lab., IL (United States); Oak Ridge National Lab., TN (United States). Apr 1992. In *Research reactor core conversion guidebook. V. 4: Fuels (Appendices I-K).* 594p. Order Number DE93607813. Source: OSTI; NTIS (US Sales Only); INIS.

As part of the RERTR Program, a whole-core demonstration in the Oak Ridge Research Reactor using LEU U_3Si_2-Al dispersion fuel began in December 1985 and was completed in March 1987. This specification describes the fabrication, inspection, and quality assurance provisions of the fuel plates for the fuel elements and shim rod fuel sections that were used in the demonstration. (author). 1 fig., 3 tabs.

3265 (IAEA-TECDOC–643(v.4), pp. 563-564) **Notional specification for MTR fuel plates/tubes at uranium densities up to 1.6 g/cm^3.** Hickey, B. (UKAEA Dounreay Nuclear Power Development Establishment (United Kingdom)). International Atomic Energy Agency, Vienna (Austria). Apr 1992. In *Research reactor core conversion guidebook. V. 4: Fuels (Appendices I-K).* 594p. Order Number DE93607813. Source: OSTI; NTIS (US Sales Only); INIS.

Various representative conditions from the MTR range of specifications are presented. At densities up to 1.2 g U/cc the manufacturing route can be by the traditional casting and rolling process. At densities greater than 1.2 g U/cc the manufacturing route utilises the U_3O_8/Al cermet process. (author).

3266 (IAEA-TECDOC–643(v.4), pp. 565-576) **Fabrication of medium enriched uranium fuel plate for KUCA critical experiment: Design, fabrication, inspection and transportation.** Kanda, K. (Kyoto Univ., Kumatori, Osaka (Japan). Research Reactor Inst.); Nakagome, Y.; Sagane, T.; Shibata, T. International Atomic Energy Agency, Vienna (Austria); Compagnie pour l'Etude et la Realisation de Combustibles Atomiques (CERCA), 75 - Paris (France). Apr 1992. In *Research reactor core conversion guidebook. V. 4: Fuels (Appendices I-K).* 594p. Order Number DE93607813. Source: OSTI; NTIS (US Sales Only); INIS.

The design, fabrication, inspection and transportation of fuel elements with MEU UAl_x-Al fuel for the C-core of the KUCA critical facility at the Kyoto University Research Reactor Institute are summarized. The C-core is a mockup of the annular coupled-core design for the 30 MW Kyoto University High Flux Reactor. The fuel elements were fabricated in France by CERCA. (author). 6 refs, 3 figs, 2 tabs.

3267 (IAEA-TECDOC–643(v.4), pp. 577-583) **Specifications for fuel elements with MEU UAl_x-Al fuel for the JMTRC reactor.** Oyamada, R. (Japan Atomic Energy Research Inst., Oarai, Ibaraki (Japan). Oarai Research Establishment); Yokemura, Y.; Takeda, K. International Atomic Energy Agency, Vienna (Austria). Apr 1992. In *Research reactor core conversion guidebook. V. 4: Fuels (Appendices I-K).* 594p. Order Number DE93607813. Source: OSTI; NTIS (US Sales Only); INIS.

The JMTRC is a pool-type critical facility operated as a neutronics mockup for the 50 MW JMTR. Prior to conversion of the JMTR to MEU UAl_x-Al fuel, extensive experiments were performed in the JMTRC to validate neutronics codes and obtain nuclear characteristics for the JMTR MEU core. Specifications for the JMTRC elements with MEU UAl_x-Al fuel are summarized along with the sampling rates for inspection of the materials, parts, and finished elements. (author). 2 figs.

3268 (IAEA-TECDOC–643(v.4), pp. 585-587) **Summary of specifications for Canadian enriched U-Al pin-type fuel.** Graham, R.D. (Atomic Energy of Canada Ltd., Chalk River, ON (Canada). Chalk River Nuclear Labs.). International Atomic Energy Agency, Vienna (Austria). Apr 1992. In *Research reactor core conversion guidebook. V. 4: Fuels (Appendices I-K).* 594p. Order Number DE93607813. Source: OSTI; NTIS (US Sales Only); INIS.

A summary is presented of the general specifications which apply to the fabrication of the fuel currently used in the NRX and NRU reactors at the Chalk River Nuclear Laboratories, Canada. The actual specifications would contain much greater detail. The fuel is a uranium-aluminium alloy pin-type design fabricated by extrusion of the U-Al fuel cores, followed by extrusion cladding with aluminum and weld-sealing the ends of the cladding to aluminum end plugs attached to the fuel cores. (author).

3269 (IAEA-TECDOC–643(v.4), pp. 589-594) **Determination of cladding thickness in fuel plates for material test and research reactors (MTR).** Goergenyi, T. (Nuklear-Chemie und -Metallurgie GmbH (NUKEM), Hanau (Germany)); Huth, U. International Atomic Energy Agency, Vienna (Austria). Apr 1992. In *Research reactor core conversion guidebook. V. 4: Fuels (Appendices I-K).* 594p. Order Number DE93607813. Source: OSTI; NTIS (US Sales Only); INIS.

Methodology for determining of cladding thickness is described. One method involves selective measurements along a sample picking out only locations of minimum cladding thickness. In the statistical method, cladding thickness measurements are carried out in exactly 1 mm intervals on both sides of the 60 mm sample length and the results are plotted on a "probability net". Investigations have shown that the results from the statistical method confirm those of the first method. (author). 2 refs, 8 figs.

3270 (IAEA-TECDOC–643(v.5)) **Research reactor core conversion guidebook. V. 5: Operations (Appendices L-N).** International Atomic Energy Agency, Vienna (Austria). Apr 1992. 153p. Order Number DE93607574. Source: OSTI; NTIS (US Sales Only); INIS.

Volume 5 consists of detailed Appendices L-N, which contain a variety of useful information on the operation of research reactors with reduced enrichment fuels. Summaries of these appendices can be found in Chapters 12-14 of Volume 1 of this guidebook. Appendix L contains a summary of necessary and recommended experiments for reactor startup. Appendix M provides information on the procedures and experiences of several reactor operators with both mixed and full cores with reduced enrichment fuels. Appendix N contains information on transportation of both fresh and spent fuel elements, on spent fuel storage, and on the US Department of Energy's receipt and financial settlement provisions for nuclear research reactor fuels. Refs, figs and tabs.

3271 (IAEA-TECDOC–643(v.5), pp. 11-16) **Startup experiments with reduced enrichment fuels.** Krull, W. (GKSS-Forschungszentrum Geesthacht GmbH, Geesthacht-Tesperhude (Germany)). International Atomic Energy Agency, Vienna (Austria). Apr 1992. In *Research reactor core conversion guidebook. V. 5: Operations (Appendices L-N).* 153p. Order Number DE93607574. Source: OSTI; NTIS (US Sales Only); INIS.

A summary of necessary and recommended experiments for startup of a reactor with reduced enrichment fuels is provided. (author). 1 ref.

3272 (IAEA-TECDOC–643(v.5), pp. 19-23) **CRNL experience with research reactor fuel conversion and mixed core**

operation. Graham, R.D. (Atomic Energy of Canada Ltd., Chalk River, ON (Canada). Chalk River Nuclear Labs.). International Atomic Energy Agency, Vienna (Austria). Apr 1992. In *Research reactor core conversion guidebook. V. 5: Operations (Appendices L-N).* 153p. Order Number DE93607574. Source: OSTI; NTIS (US Sales Only); INIS.

The NRX and NRU reactors at CRNL, both originally fuelled with natural uranium metal, have undergone a number of fuel conversions before arriving at the present highly enriched uranium-aluminium alloy fuel designs. The history of the changes and the regulatory approvals required to make the changes are summarized. (author). 2 tabs.

3273 (IAEA-TECDOC–643(v.5), pp. 25-38) **Experience with mixed cores in the ASTRA reactor.** Casta, J. (Oesterreichisches Forschungszentrum Seibersdorf GmbH (Austria)). International Atomic Energy Agency, Vienna (Austria). Apr 1992. In *Research reactor core conversion guidebook. V. 5: Operations (Appendices L-N).* 153p. Order Number DE93607574. Source: OSTI; NTIS (US Sales Only); INIS.

Core configurations composed of different MTR-type fuel elements were operated in the ASTRA-reactor. A thermal hydraulics analysis was performed by calculating the safety margins. Results of measurements of LEU-test elements in the ASTRA-core are presented. (author). 1 ref., 9 figs, 3 tabs.

3274 (IAEA-TECDOC–643(v.5), pp. 39-50) **HEU-MEU mixed core experiments in the KUCA.** Kanda, K. (Kyoto Univ., Kumatori, Osaka (Japan). Research Reactor Inst.); Shiroya, S.; Hayashi, M.; Kobayashi, K.; Shibata, T. International Atomic Energy Agency, Vienna (Austria). Apr 1992. In *Research reactor core conversion guidebook. V. 5: Operations (Appendices L-N).* 153p. Order Number DE93607574. Source: OSTI; NTIS (US Sales Only); INIS.

In response to a request from the consultants' meeting of the IAEA, the HEU-MEU mixed-core experiments in the KUCA were started in April 1984. The HEU-MEU mixed-core employed in the KUCA experiments was a light-water-moderated and heavy-water-reflected coupled-core. Several patterns of HEU-MEU mixed-cores employed in the KUCA coupled-core experiments were broadly classified into two categories. The first was called as "Separate Core" in which one cylindrical core consisted of only HEU fuel and the other MEU fuel. The second was called as "Mixed Core" in which each cylindrical core consisted of both HEU and MEU fuels. For these cores, the critical mass and the reactivity worth of the control rod were measured. For "Separate Core", the effect of boron burnable-poison and the neutron flux distribution were also investigated. In both "Separate Core" and "Mixed Core", the number of fuel plates in each cylindrical core of the coupled cores was maintained as the same number. The imbalance of neutron importance between the two coupled cores was observed through the present KUCA mixed-core experiments, since the MEU fuel plate had a slightly higher reactivity effect than the HEU fuel plate. The reactivity worth of each control rod varied from case to case depending on the mixed-core configuration. In other words, the worth depended on the balance of neutron importance between the two coupled cores. However, the total reactivity worth of the control rods gave approximately the same value in any mixed-core configuration. (author). 18 refs, 6 figs, 3 tabs.

3275 (IAEA-TECDOC–643(v.5), pp. 51-66) **The transition phase of the whole-core demonstration at the Oak Ridge Research Reactor.** Hobbs, R.W. (Oak Ridge National Lab., TN (United States)); Bretscher, M.M.; Cornella, R.J.; Snelgrove, J.L. International Atomic Energy Agency, Vienna (Austria). Apr 1992. In *Research reactor core conversion guidebook. V. 5: Operations (Appendices L-N).* 153p. Order Number DE93607574. Source: OSTI; NTIS (US Sales Only); INIS.

The transition from operation of the Oak Ridge Research Reactor with high-enrichment uranium (HEU) fuel to operation with low-enrichment uranium (LEU) fuel is nearing completion. The systematics of the replacement of the HEU fuel with the LEU fuel are discussed. The results of the core physics measurements that have been conducted during the transition phase are described. (author). 5 refs, 12 figs, 4 tabs.

3276 (IAEA-TECDOC–643(v.5), pp. 73-81) **Full core MEU fuel demonstration in the JMTR.** Saito, M. (Japan Atomic Energy Research Inst., Oarai, Ibaraki (Japan). Oarai Research Establishment); Nagaoka, Y.; Shimakawa, S.; Nakayama, F.; Oyamada, R.; Okamoto, Y. International Atomic Energy Agency, Vienna (Austria). Apr 1992. In *Research reactor core conversion guidebook. V. 5: Operations (Appendices L-N).* 153p. Order Number DE93607574. Source: OSTI; NTIS (US Sales Only); INIS.

The joint ANL-JAERI program for the RERTR was started in January 1980. The final goal of this program is to achieve the full core conversion to LEU in the JMTR. In 1980, the LEU fuel with silicide had not been qualified yet. In this situation, the MEU fuel was selected for the first stage, and integrity of the MEU fuel was confirmed through the following three steps: (1) hydraulic test, (2) critical experiments in the JMTRC (Japan Materials Testing Reactor Critical Facility), and (3) irradiation test in the JMTR. In August 1986, the full core MEU fuel demonstration test had been successfully completed. (author). 2 refs, 4 figs, 10 tabs.

3277 (IAEA-TECDOC–643(v.5), pp. 85-92) **Transportation of MTR fuel elements within the Federal Republic of Germany.** International Atomic Energy Agency, Vienna (Austria); Transnuklear GmbH, Hanau (Germany). Apr 1992. In *Research reactor core conversion guidebook. V. 5: Operations (Appendices L-N).* 153p. Order Number DE93607574. Source: OSTI; NTIS (US Sales Only); INIS.

Since April 1982, a regulation has been introduced in Germany that requires transports of HEU and Pu (including MTR fuel elements) to be performed by a special safety vehicle called "SIFA". A summary of transport regulations as of August 1982 is provided along with data on fresh fuel shipping containers and the SIFA safety vehicle. (author).

3278 (IAEA-TECDOC–643(v.5), pp. 149-153) **Receipt and financial settlement provisions for nuclear research reactor fuels.** International Atomic Energy Agency, Vienna (Austria); US-DOE, Washington, DC (United States). Apr 1992. In *Research reactor core conversion guidebook. V. 5: Operations (Appendices L-N).* 153p. Order Number DE93607574. Source: OSTI; NTIS (US Sales Only); INIS.

U.S. Federal Register notices (as of 30 December 1987) on DOE's "Receipt and Financial Settlement Provisions for Nuclear Research Reactor Fuels" are provided. DOE's current commitment to provide receipt and financial settlement services for qualifying research reactor fuels extends until 31 December 1988 for HEU fuels and until 31 December 1992 for LEU fuels. The need for extension beyond these dates will be evaluated by DOE when appropriate. (author).

3279 (IEN–33/92) **New instrumentation for the IPR-R1 reactor of CDTN.** Carvalho, P.V.R. de. Instituto de Engenharia Nuclear (IEN), Rio de Janeiro, RJ (Brazil). Jan 1992. 20p. (In Portuguese). Order Number DE93607814. Source: OSTI; NTIS (US Sales Only); INIS.

The Nuclear Engineering Institute reactor instrumentation area has developed systems and equipment for reactor operation and safety. In such way, the new I and C for IEN Argonauta reactor and the nuclear instrumentation for IPEN critical facility were built. This paper describes our real work, the new I and C systems for IPR-R1, a Triga type reactor, located at CDTN (Belo Horizonte - MG). (author).

3280 (INIS-BR–2942, pp. 112-113) **Analysis of thermohydraulic limits for R.P.R. reactor.** Botelho, D.A. (Instituto de Engenharia Nuclear (IEN), Rio de Janeiro, RJ (Brazil). Div. de Termohidraulica de Reatores). Instituto de Engenharia Nuclear (IEN), Rio de Janeiro, RJ (Brazil). Dept. de Reatores. 1989. 147p. (In Portuguese). (CONF-880440–: 2. Brazilian meeting on nuclear energy, Rio de Janeiro (Brazil), 23-26 Apr 1988). In *Triennial technical report - 1986, 1987, 1988 - Instituto de Engenharia Nuclear (IEN) -Dept. of Reactors (DERE).* Order Number DE93605069. Source: OSTI; NTIS (US Sales Only); INIS.

Published in summary form only. ISOTOPE PRODUCTION REACTORS/thermal conduction; ISOTOPE PRODUCTION REACTORS/thermodynamic properties; CONVECTION; CRITICAL HEAT

FLUX; FLUID FLOW; LIMITING VALUES; TWO-DIMENSIONAL CALCULATIONS

3281 (INIS-BR–2942, pp. 126) **Thermohydraulics limits analysis in a radioisotope production reactor.** Botelho, D.A. (Instituto de Engenharia Nuclear (IEN), Rio de Janeiro, RJ (Brazil). Div. de Termohidraulica de Reatores). Instituto de Engenharia Nuclear (IEN), Rio de Janeiro, RJ (Brazil). Dept. de Reatores. 1989. 147p. (In Portuguese). (CONF-880440–: 2. Brazilian meeting on nuclear energy, Rio de Janeiro (Brazil), 23-26 Apr 1988). In *Triennial technical report - 1986, 1987, 1988 - Instituto de Engenharia Nuclear (IEN) -Dept. of Reactors (DERE).* Order Number DE93605069. Source: OSTI; NTIS (US Sales Only); INIS.

Published in summary form only. ISOTOPE PRODUCTION REACTORS/limiting values; ISOTOPE PRODUCTION REACTORS/thermodynamics; CONVECTION; CRITICAL HEAT FLUX; HYDRAULICS; THERMODYNAMICS; POOL TYPE REACTORS; THERMAL CONDUCTION; TWO-DIMENSIONAL CALCULATIONS

3282 (INIS-BR–2951) **Determination of one spectral index at the argonaut reactor.** Klawa, R. Universidade Federal, Rio de Janeiro, RJ (Brazil). Coordenacao dos Programas de Pos-graduacao de Engenharia. 1973 88p. (In Portuguese). Order Number DE93607815. Source: OSTI; NTIS (US Sales Only); INIS.

One spectral index at the Argonauta Reactor was determined. The Westcott formalism was employed assuming two components: Maxwellian and 1/E. The values of g(T) and s(T) were obtained from the Westcott definitions by means of the Breit - Wigner formula for the cross section. The r and T were determined for one point at the core of Argonauta Reactor. (author).

3283 (INIS-BR–2976) **Decay constants of subcritical system by diffusion theory for two groups.** Moura Neto, C. de. Instituto Militar de Engenharia (IME), Rio de Janeiro, RJ (Brazil). 1977 113p. (In Portuguese). Order Number DE93607816. Source: OSTI; NTIS (US Sales Only); INIS.

The effects of a neutronic pulse applied to a subcritical multiplicative medium are analysed on the basis of the diffusion theory for one and two groups. The decay constants of the system for various values of geometric buckling were determined from the experimental data. A natural uranium-light water lattice was pulsed employing a Texas Nuclear 9905 neutron generator. The least square method was employed in the data reduction procedures to determine the decay constants. The separation of the decay constants associated with thermal and epithermal fluxes is attempted through two groups formulation. (author).

3284 (INIS-BR–3059) **Measurement of the epithermal neutron flux of the Argonauta reactor by the Sandwich method.** Nascimento, H.M. Universidade Federal, Rio de Janeiro, RJ (Brazil). Coordenacao dos Programas de Pos-graduacao de Engenharia. 1973 127p. (In Portuguese). Order Number DE93607817. Source: OSTI; NTIS (US Sales Only); INIS.

A common method of obtaining information about the neutron spectrum in the energy range of 1 eV to a few keV is by using resonance sandwich detectors. A sandwich detector is usually made up of three foils placed one on top of the other, each having the same thickness and being made of the same material which has a pronounced absorption resonance. To make an adequate evaluation, the sandwich method was compared with one using an isolated detector. The results obtained from approximate theoretical calculations were checked experimentally, using In, Au and Mn foils, in an isotropic 1/E flux in the Argonaut Reactor at I.E.N. As practical application of this method, the deviation from a 1/E spectrum of the epithermal neutron flux in the core and external graphite reflector of the Argonaut Reactor has been measured with the sandwich foils previously calibrated in a 1/E spectrum. (author).

3285 (INIS-mf–13375) **Seminar on the use of research reactors in fundamental and applied sciences. Programme and abstracts.** Tajoura Nuclear Research Centre, Tripoli (Libyan Arab Jamahiriya). 1984 82p. (CONF-8409421–: Seminar on the use of research reactors in fundamental and applied sciences, Tajoura (Libyan Arab Jamahiriya), 16 Sep 1984). Order Number DE93606515. Source: OSTI; NTIS (US Sales Only); INIS.

The document includes the programme and the abstracts of papers presented at the "Seminar on the use of research reactors in fundamental and applied sciences" organized by the Tajoura Nuclear Research Centre in cooperation with the IAEA at Tajoura, Tripoli (Libya) between 16-20 September 1984. The abstracts are grouped in seven sessions: reactor physics (five abstracts), research reactor programmes (three abstracts), solid state physics (two abstracts), nuclear physics (two abstracts), radiochemistry (eleven abstracts), activation analysis (five abstracts), diverse topics (six abstracts). Separate indexing was provided for each abstract.

3286 (INIS-mf–13375, pp. 7) **Analysis of the Tajoura reactor core with an Albedo-matrix model for the reflector.** Mabruk Methnani (Reactor Department, TNRC, Tripoli (Libya)). Tajoura Nuclear Research Centre, Tripoli (Libyan Arab Jamahiriya). 1984. 82p. (CONF-8409421–: Seminar on the use of research reactors in fundamental and applied sciences, Tajoura (Libyan Arab Jamahiriya), 16 Sep 1984). In *Seminar on the use of research reactors in fundamental and applied sciences. Programme and abstracts.* Order Number DE93606515. Source: Also available from Tajoura Nuclear Research Centre, Tajoura/Tripoli, Libya.

Short communication. IVV-7 REACTOR/reactor cores; REACTOR CORES/neutron reflectors; ALBEDO; NEUTRON TRANSPORT THEORY

3287 (INIS-mf–13375, pp. 47) **Cold neutron source and its application in solid state physics and biology.** Stein (Interatom (Germany)). Tajoura Nuclear Research Centre, Tripoli (Libyan Arab Jamahiriya). 1984. 82p. (CONF-8409421–: Seminar on the use of research reactors in fundamental and applied sciences, Tajoura (Libyan Arab Jamahiriya), 16 Sep 1984). In *Seminar on the use of research reactors in fundamental and applied sciences. Programme and abstracts.* Order Number DE93606515. Source: Also available from Tajoura Nuclear Research Centre, Tajoura/Tripoli, Libya.

Short communication. COLD NEUTRONS/biology; COLD NEUTRONS/solid state physics; BIOLOGY; RESEARCH REACTORS; USES

3288 (INIS-mf–13375, pp. 48) **The installation of a cold neutron source at the FRG-1 reactor and connecting upgrading activities.** Krull, W. (GKSS (Germany)). Tajoura Nuclear Research Centre, Tripoli (Libyan Arab Jamahiriya). 1984. 82p. (CONF-8409421–: Seminar on the use of research reactors in fundamental and applied sciences, Tajoura (Libyan Arab Jamahiriya), 16 Sep 1984). In *Seminar on the use of research reactors in fundamental and applied sciences. Programme and abstracts.* Order Number DE93606515. Source: Also available from Tajoura Nuclear Research Centre, Tajoura/Tripoli, Libya.

Short communication. FRG-1 REACTOR/cold neutrons; MODIFICATIONS

3289 (INIS-mf–13375, pp. 12) **Radioisotope program in Iran.** Owlya, A. (Nuclear Research Centre, Atomic Energy Organization of (Iran)). Tajoura Nuclear Research Centre, Tripoli (Libyan Arab Jamahiriya). 1984. 82p. (CONF-8409421–: Seminar on the use of research reactors in fundamental and applied sciences, Tajoura (Libyan Arab Jamahiriya), 16 Sep 1984). In *Seminar on the use of research reactors in fundamental and applied sciences. Programme and abstracts.* Order Number DE93606515. Source: Also available from Tajoura Nuclear Research Centre, Tajoura/Tripoli, Libya.

Short communication. UTRR REACTOR/isotope production; RADIOISOTOPE GENERATORS; RESEARCH PROGRAMS; TECHNETIUM 99

3290 (Juel–2604) **Neutron physical investigations for the Indonesian research reactor MPR-30 with regard to the use of silicide fuel elements.** Lasman, A.N. Forschungszentrum Juelich GmbH (Germany). Inst. fuer Sicherheitsforschung und Reaktortechnik; Technische Hochschule Aachen (Germany). Mar 1992. 102p. (In German). Order Number DE93728869. Source: OSTI; NTIS (US Sales Only); INIS.

Since the beginning of the MPR-30 operation attempts have been made to improve the use of the fuel elements in order to reach higher burnup as well as to increase the operational safety and the availability of the plant. The neutron economy using

U_3Si_2Al instead of U_3O_8Al in different core configurations of the MPR-30 has been analyzed. The choice of U_3Si_2Al fuel elements motivated by the INFCE recommendations was encouraged by material and technical experiments. This analysis was performed with the computer program system RSYST. It covered calculations of neutron spectra using multigroup SN representations, 2-D full core diffusion calculations in 5 broad energy groups and detailed burnup calculations for all fuel elements in the core. From this information k_{eff}, flux- and power distribution and reactor core lifetime was deduced. In addition temperature coefficients and control rod efficiencies were calculated. A comparison between oxide and silicide fuel elements shows the principal feasibility of silicide fuel cores for MPR-30. (orig./HP).

3291 (SR/H–253) **Gas Generation Hydrostatic Test Program.** Du Pont de Nemours (E.I.) and Co., Wilmington, DE (United States). Explosives Dept. 18 Mar 1953. 10p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC09-76SR00001. Order Number DE93002719. Source: OSTI; NTIS (US Sales Only); GPO Dep.

Attached for your information are two copies of the Hydrostatic Test Program for the Gas Generating Area. This procedure covers in detail testing and inspection which will be carried out in this area. Testing and inspection gas generation, equipment, storage tanks and lines, and run down tanks and lines has been set up on a twelve month frequency. It should be noted that the attached program includes some minor maintenance items which will be done during the 1953 testing.

3292 (SR/H–254) **Hydrostatic testing and pressure relieving safety devices.** Morris, J.W. Du Pont de Nemours (E.I.) and Co., Wilmington, DE (United States). Explosives Dept. 25 Feb 1953. 5p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC09-76SR00001. Order Number DE93002720. Source: OSTI; NTIS (US Sales Only); GPO Dep.

Subject letter suggests that the plants set up systems for exercising control over the testing and setting of pressure relief devices and the use of pressure vessels. It is felt that the program which Dana Plant now has underway meets the objectives as outlined. Under Safety and Fire Protection Procedure No. 23, STET attached, a committee has been set up to serve in an advisory capacity on protection of pressure equipment. This committee is established as a suitable level to be well qualified in its recommendations and to have access to the specific details necessary for accuracy in its functions. The responsibilities assigned to the committee are outlined in the procedure. It is believed that this responsibility adequately covers the following specific recommendations of your letter. Establish frequency and condition of testing of safety devices; control of relief valve settings, and other protective devices; establish and maintain an inventory of pressure vessels and protective devices. A brief review of the committee's activity and program is attached.

3293 (WHC-SA–1536) **A facility for testing 10- to 100-kWe space power reactors.** Carlson, W.F.; Bitten, E.J. Westinghouse Hanford Co., Richland, WA (United States). Jun 1992. 9p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-87RL10930. (CONF-930103–9: 10. symposium on space nuclear power and propulsion, Albuquerque, NM (United States), 10-14 Jan 1993). Order Number DE92040420. Source: OSTI; NTIS (US Sales Only); GPO Dep.

This paper describes an existing facility that could be used in a cost-effective manner to test space power reactors in the 10 to 100-kWe range before launch. The facility has been designed to conduct full power tests of 100-kWe SP-100 reactor systems and already has the structural feature that would be required for lower power testing. The paper describes a reasonable scenario starting with the acceptance at the test site of the unfueled reactor assembly and the separately shipped nuclear fuel. After fueling the reactor and installing it in the facility, cold critical tests are performed, and the reactor is then shipped to the launch site. The availability of this facility represents a cost-effective means of performing the required prelaunch test program.

3294 (Y/DZ–919) **Nerva fuel nondestructive evaluation and characterization equipment and facilities.** Caputo, A.J. Oak Ridge Y-12 Plant, TN (United States). 22 Jul 1992. 22p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OS21400. (CONF-930103–7: 10. symposium on space nuclear power and propulsion, Albuquerque, NM (United States), 10-14 Jan 1993). Order Number DE92019487. Source: OSTI; NTIS (US Sales Only); GPO Dep.

The objective of the risk-based configuration control is to detect and control plant configurations from a risk perspective. The configurations of particular interest involve components which are down during power operation. Controlling plant configurations from a risk-perspective can provide more direct risk control and also more operational flexibility by allowing looser control in areas unimportant to risk.

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Refer also to citation(s) 2849, 2851, 3032, 3050, 3075, 3080, 3082, 3083, 3122, 3134, 4038, 4361, 4786

3295 (BNL-NUREG–47531) **Requirements and capabilities of PSA for safety management applications.** Hirschberg, S. (International Atomic Energy Agency, Vienna (Austria)); Johanson, G.; Samanta, P.K. Brookhaven National Lab., Upton, NY (United States). [1992]. 6p. Sponsored by Nuclear Regulatory Commission, Washington, DC (United States). DOE Contract AC02-76CH00016. (CONF-930116–3: Probabilistic safety assessment international topical meeting, Clearwater Beach, FL (United States), 27-29 Jan 1993). Order Number DE92017697. Source: OSTI; NTIS; INIS; GPO Dep.

The International Atomic Energy Agency (IAEA) has prepared a draft document providing guidance to the Member States on the various application areas for PSAs for the intended applications. Requirements for applying a PSA in each of the specific application areas have been defined. This includes definition of the objectives of the application, PSA modeling and data requirements, calculational capabilities, and the requirements for presentation of results. This document provides an example for one of the 17 areas, namely "Evaluation of Surveillance and Maintenance Activities."

3296 (BNL-NUREG–47537) **A risk-based evaluation of action requirements for failures in systems required for shutdown.** Mankamo, T. (Avaplan Oy, Espoo (Finland)); Kim, I.; Samanta, P. Brookhaven National Lab., Upton, NY (United States). [1992]. 4p. Sponsored by Nuclear Regulatory Commission, Washington, DC (United States). DOE Contract AC02-76CH00016. (CONF-930116–4: Probabilistic safety assessment international topical meeting, Clearwater Beach, FL (United States), 27-29 Jan 1993). Order Number DE92017699. Source: OSTI; NTIS; INIS; GPO Dep.

Short communication. BWR TYPE REACTORS/after-heat removal; REACTOR SHUTDOWN; AFTER-HEAT; SENSITIVITY ANALYSIS; FAILURES; REACTOR COOLING SYSTEMS; ENGINEERED SAFETY SYSTEMS; REACTOR SAFETY; AUXILIARY SYSTEMS

3297 (BNL-NUREG–47538) **Risk-based configuration control: Application of PRA in improving technical specifications and operational safety.** Samanta, P.K. (Brookhaven National Lab., Upton, NY (United States)); Kim, I.S.; Vesely, W.E. Brookhaven National Lab., Upton, NY (United States). [1991]. 4p. Sponsored by Nuclear Regulatory Commission, Washington, DC (United States). DOE Contract AC02-76CH00016. (CONF-930116–2: Probabilistic safety assessment international topical meeting, Clearwater Beach, FL (United States), 27-29 Jan 1993). Order Number DE92017698. Source: OSTI; NTIS; INIS; GPO Dep.

The objective of risk-based configuration control is to detect and control plant configurations form a risk perspective. The configurations of particular interest involve components which are down during power operation. Controlling plant configurations from a risk-perspective can provide more direct risk control and also more operational flexibility by allowing looser control in areas unimportant to risk.

3298 (BNL-NUREG–47880) **Risk effectiveness evaluation of surveillance testing.** Martorell, S. (Universidad Politecnica de Valencia (Spain). Dept. de Ingenieria Quimica y Nuclear); Kim, I.S.;

Samanta, P.K.; Vesely, W.E. Brookhaven National Lab., Upton, NY (United States). 20 Jul 1992. 6p. Sponsored by Nuclear Regulatory Commission, Washington, DC (United States). DOE Contract AC02-76CH00016. (CONF-9210186–1: 18. annual meeting of the Spanish Nuclear Society (SNS), Puerto de Santa Maria (Spain), 28-30 Oct 1992). Order Number DE93001435. Source: OSTI; NTIS; INIS; GPO Dep.

In nuclear power plants surveillance tests are required to detect failures in standby safety system components as a means of assuring their availability in case of an accident. However, the performance of surveillance tests at power may have adverse impact on safety as evidenced by the operating experience of the plants. The risk associated with a test includes two different aspects: (1) a positive aspect, i.e., risk contribution detected by the test, that results from the detection of failures which occur between tests and are detected by the test, and (2) a negative aspect, i.e., risk contribution caused by the test, that includes failures and degradations which are caused by the test or are related to the performance of the test. In terms of the two different risk contributions, the risk effectiveness of a test can be simply defined as follows: a test is risk effective if the risk contribution detected by the test is greater than the risk contribution caused by the test; otherwise it is risk ineffective. The methodology presentation will focus on two important kinds of negative test risk impacts, that is, the risk impacts of test-caused transients and equipment wear-out. The evaluation results of the risk effectiveness of the test will be presented in the full paper along with the risk assessment methodology and the insights from the sensitivity analysis. These constitute the core of the NUREG/CR-5775.

3299 (CONF-921007–2) **Magnitude and reactivity consequences of accidental moisture ingress into the Modular High-Temperature Gas-Cooled Reactor core.** Smith, O.L. Oak Ridge National Lab., TN (United States). [1992]. 17p. Sponsored by Nuclear Regulatory Commission, Washington, DC (United States). DOE Contract AC05-84OR21400. From 20. water reactor safety information meeting; Bethesda, MD (United States); 21-23 Oct 1992. Order Number DE93002426. Source: OSTI; NTIS; INIS; GPO Dep.

Accidental admission of moisture into the primary system of a Modular High-Temperature Gas-Cooled Reactor (MHTGR) has been identified in US Department of Energy-sponsored studies as an important safety concern. The work described here develops an analytical methodology to quantify the pressure and reactivity consequences of steam-generator tube rupture and other moistureingress-related incidents. Important neutronic and thermohydraulic processes are coupled with reactivity feedback and safety and control system responses. Rate and magnitude of steam buildup are found to be dominated by major system features such as break size in comparison with safety valve capacity and reliability, while being less sensitive to factors such as heat transfer coefficients. The results indicate that ingress transients progress at a slower pace than previously predicted by bounding analyses, with milder power overshoots and more time for operator or automatic corrective actions.

3300 (DPW–5540) **Hanford safety rod snubber.** Toops, E.C. Du Pont de Nemours (E.I.) and Co., Wilmington, DE (United States). Explosives Dept. 3 Jun 1952. 2p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC09-76SR00001. (SR/H–237). Order Number DE93001914. Source: OSTI; NTIS (US Sales Only); GPO Dep.

This memorandum provides details of a trip to Hanford to investigate a new safety rod snubber design. This new design is briefly discussed.

3301 (DPW–5910) **Radiation around semi-permanent sleeve.** Flannagan, G.N. Du Pont de Nemours (E.I.) and Co., Wilmington, DE (United States). Explosives Dept. 23 Jul 1956. 5p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC09-76SR00001. (SR/H–210). Order Number DE93001237. Source: OSTI; NTIS (US Sales Only); GPO Dep.

The semi-permanent sleeve through the plenum chambers and top shield is surrounded by annuli through which an appreciable quantity of radiation may escape after pile shutdown. This memorandum presents calculations of the radiation expected from the top of this sleeve from a 700 MW/100 ton pile four hours after shutdown. This memorandum discusses computations made by two different methods gave radiation intensity out of the semi-permanent sleeve of approximately 10–15 mr/hr. in the beam at four hours after shutdown. Twenty-four hours after shutdown the beam intensity would be 5–7.5 mr/hr.

3302 (EGG-M–92391) **RELAP5 assessment of noncondensable test data for passive cooling applications.** Kullberg, C. EG and G Idaho, Inc., Idaho Falls, ID (United States). [1992]. 4p. Sponsored by Nuclear Regulatory Commission, Washington, DC (United States). DOE Contract AC07-76ID01570. (CONF-921102–23: Joint American Nuclear Society (ANS)/European Nuclear Society (ENS) international meeting on fifty years of controlled nuclear chain reaction: past, present, and future, Chicago, IL (United States), 15-20 Nov 1992). Order Number DE93001967. Source: OSTI; NTIS; INIS; GPO Dep.

Condensation heat transfer in the presence of noncondensable (NC) gases is of concern in the design of passive heat removal systems for a number of recently proposed advanced reactor designs. In general, the presence of NCs will degrade the efficiency of such passive heat removal systems and, in some cases, induce unstable flow patterns. As part of a research effort to better understand passive heat removal dynamics, a series of numerical steady-state simulations in the presence of NCs were performed to evalutate RELAP5/MOD3 against test data. This assessment was made using data from the University of California, Berkeley (UCB) natural circulation loop test facility. For fine enough nodalization in the condenser region, the RELAP5/MOD3 simulations generally captured the same phenomena as observed in the tests.

3303 (EGG-M–92423) **Tangent space analysis of two phase systems near the critical temperature.** Kullberg, C. EG and G Idaho, Inc., Idaho Falls, ID (United States). [1992]. 4p. Sponsored by Nuclear Regulatory Commission, Washington, DC (United States). DOE Contract AC07-76ID01570. (CONF-921102–24: Joint American Nuclear Society (ANS)/European Nuclear Society (ENS) international meeting on fifty years of controlled nuclear chain reaction: past, present, and future, Chicago, IL (United States), 15-20 Nov 1992). Order Number DE93001966. Source: OSTI; NTIS; INIS; GPO Dep.

In certain circumstances, reactor transient computer simulations lead to system conditions which approach or exceed the critical temperature. Such transients include accident scenarios where there is a loss of heat sink coincident with failure to scram. Near or above the critical temperature, many analysts have observed unusual reactor system behavior and in some cases code failures. In some circumstances, the flavor of these transients can be captured with simplified mathematical models that have embedded within them the same kind of nonlinear behavior. One way of analyzing the solution behavior near the critical temperature is to examine the algebraic and geometric characteristics of the equations. For system models with many degrees of freedom this proves to be an extremely difficult task. As a consequence, a simplified set of equations approximated with two degrees of freedom (equivalent two-dimensional phase space) is used to model the global system response. Known algebraic/geometric techniques are used to globally identify how the solutions evolve as a function of time. Two phase system models with only two degrees of freedom can become extremely complex in an algebraic context when reduced to a set of autonomous differential equations. Most of this complexity is embedded in the algebraic expressions for the equation of state. When the state equations are invoked, the symbolic expressions for the resultant transformed conservation equations contain hundreds of terms. However, a new class of symbolic software packages allows one to generate and manipulate such complex ions with relative ease. This technology was used in part to generate the numerical results presented in this paper.

3304 (EGG-NRRT–10332) **Safety requirements, facility user needs, and reactor concepts for a new Broad Application Test Reactor.** Ryskamp, J.M. (ed.); Liebenthal, J.L.; Denison, A.B.; Fletcher, C.D. EG and G Idaho, Inc., Idaho Falls, ID (United States). Jul 1992. 125p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC07-76ID01570. Order Number DE93002039. Source: OSTI; NTIS; INIS; GPO Dep.

This report describes the EG&G Laboratory Directed Research and Development Program (LDRD) Broad Application Test Reactor (BATR) Project that was conducted in fiscal year 1991. The scope of this project was divided into three phases: a project process definition phase, a requirements development phase, and a preconceptual reactor design and evaluation phase. Multidisciplinary teams of experts conducted each phase. This report presents the need for a new test reactor, the project process definition, a set of current and projected regulatory compliance and safety requirements, a set of facility user needs for a broad range of projected testing missions, and descriptions of reactor concepts capable of meeting these requirements. This information can be applied to strategic planning to provide the Department of Energy with management options.

3305 (HW–24191) **Application of Reactor Safeguard Committee formula.** Smith, J.M. Hanford Works, Richland, WA (United States). 22 Apr 1952. 8p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE93002144. Source: OSTI; NTIS (US Sales Only); GPO Dep.

The Reactor Safeguard Committee formula for the allowable minimum distance between a reactor and the public domain is expressed as: $r = 0.01\sqrt{P}$, where r = radius from reactor in miles, and P = reactor power level in kilowatts. The six plates in this report illustrates the application of this formula for Hanford Works, both for individual reactors and all reactors in an area.

3306 (HW–30751) **Reactor Section, Radiation Monitoring Sub-Section monthly report (administrative), January 1954.** Jerman, P.C. Hanford Atomic Products Operation, Richland, WA (United States). 3 Feb 1954. 4p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE93001729. Source: OSTI; NTIS (US Sales Only); GPO Dep.

This monthly document provides activities of the Radiation Monitoring group of the Reactor Section during the month of January 1954.

3307 (HW–34328-RD) **Reactor Section, Radiaton Monitoring Sub-Section monthly report, December 1954.** Jerman, P.C. Hanford Atomic Products Operation, Richland, WA (United States). 5 Jan 1955. 4p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE93001733. Source: OSTI; NTIS (US Sales Only); GPO Dep.

This monthly document provides activities of the Radiation Monitoring Group of the Reactor Section during the month of December 1954.

3308 (HW–44708-Vol.1-Rev.) **Hazards summary report – Projects CG-558 and CG-600 reactor plant modifications: Volume 1, Revision.** Trumble, R.E. General Electric Co., Richland, WA (United States). Hanford Atomic Products Operation. 6 Mar 1957. 80p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE93000325. Source: OSTI; NTIS (US Sales Only); GPO Dep.

The scope of projects CG-558 and CG-600, a discussion of reactor hazards, a technical summary of pertinent aspects of reactor control and reactor cooling, and a discussion of development programs designed to increase efficiency of operation and further decrease the hazards are included in this document Volume 1 of this report.

3309 (HW–62471) **Preliminary hazards review operational charge-discharge for Hanford reactors.** Carlson, P.A.; Trumble, R.E. General Electric Co., Richland, WA (United States). Hanford Atomic Products Operation. 26 Oct 1959. 16p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE93000326. Source: OSTI; NTIS (US Sales Only); GPO Dep.

The use of the porposed full reactor operational charge-discharge facilities will to some degree change the method of reactor operation from a "batch" to a "continuous" process. This change in the operational process will require modifications to coolant flow supply and monitoring equipment. Since a continuous and adequate coolant supply is essential to prevention of the release of fission products from the irradiated fuel elements this modification merits a hazards analysis.

3310 (HW–76886) **Consequences of a production reactor accident.** Junkins, R.L.; Watson, E.C. General Electric Co., Richland, WA (United States). Hanford Atomic Products Operation. 8 Mar 1963. 30p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE93002085. Source: OSTI; NTIS (US Sales Only); GPO Dep.

The purpose of this report is to estimate the consequences of a Hanford reactor accident with emphasis on the effects at distant points. The potential effects in Canada are estimated as well as the consequences within the United States.

3311 (HW–79792) **Reactor power level limits.** Owsley, G.F.; Ambrose, T.W. General Electric Co., Richland, WA (United States). Hanford Atomic Products Operation. 3 Dec 1963. 9p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE93002086. Source: OSTI; NTIS (US Sales Only); GPO Dep.

This document is submitted in response to a request from the Atomic Energy Commission for a report on the safety aspects of reactor operation at bulk outlet temperatures in the neighborhood of 95 C. To properly describe the safety aspects of operation it is necessary to address the report to the engineering parameters associated with reactor operation and compare them to actual technical limits. Also, some discussion of administrative power level limits and bulk outlet temperature is in order.

3312 (KFK–4990) **Consequences and effectiveness of relocation after nuclear accidents.** Qu Jingyuan. Kernforschungszentrum Karlsruhe GmbH (Germany). Inst. fuer Neutronenphysik und Reaktortechnik; Kernforschungszentrum Karlsruhe GmbH (Germany). Projekt Nukleare Sicherheitsforschung; Karlsruhe Univ. (T.H.) (Germany). Fakultaet fuer Maschinenbau. Feb 1992. 152p. (In German). Order Number DE93728948. Source: OSTI; NTIS (US Sales Only); INIS.

Extensive parameter studies have been performed with the program package COSYMA for probabilistic accident consequence assessments to quantify by means of PRA methods the interdependence of those quantities, which influence the extent, the duration, the efficiency and the monetary costs of relocation. As most important quantities, the amount of radionuclides released, the dose intervention levels for relocation, the (avoided) radiation doses in the population and the associated costs have been identified. Decontamination measures have also been included in the investigations, since they reduce the duration of relocation. The expression of all relevant accident consequences in monetary units allowed to investigate the applicability of cost/benefit analysis for deriving the most favourable intervention levels. It could be shown that weighting with different factors of collective doses calculated from different individual dose bands, and thus incorporating subjective judgements, significantly extends and improves the method. (orig./HP).

3313 (NKS–92-1) **The Nordic programme for nuclear safety 1990-1993: Report for 1991.** Nordisk Kernesikkerhedsforskning, Roskilde (Denmark). Feb 1992. 78p. (In Danish, Swedish, Norwegian, English). Order Number DE93607341. Source: OSTI; NTIS; INIS.

The report, covering the year 1991 of the Nordic Programme for Nuclear Safety 1990-1993, presents 18 projects divided into 4 main areas: preparedness in abnormal radiation situations, nuclear wastes and shutdowns, radioecology and reactor safety - knowledge preparedness. The main areas are briefly described and the status of each project is presented. (CLS) (118 refs.).

3314 (NUREG–0797-Suppl.25) **Safety Evaluation Report related to the operation of Comanche Peak Steam Electric Station, Unit 2 (Docket No. 50-446): Supplement No. 25.** Nuclear Regulatory Commission, Washington, DC (United States). Div. of Reactor Projects, III, IV, V. Sep 1992. 113p. Sponsored by Nuclear Regulatory Commission, Washington, DC (United States). Source: OSTI; NTIS; INIS; GPO.

This document supplement 25 to the Safety Evaluation Report related to the operation of the Comanche Peak Steam Electric Station (CPSES), Unit 2 (NUREG-0797), has been prepared by the Office of Nuclear Reactor Regulation of the US Nuclear Regulatory Commission (NRC). The facility is located in Somervell County, Texas, approximately 40 miles southwest of Fort Worth, Texas. This supplement reports the status of certain issues that had not been resolved when the Safety Evaluation Report and Supplements 1, 2, 3, 4, 6, 12, 21, 22, 23, and 24 to that report were published. This supplement deals primarily with Unit 2 issues; however, it also references evaluations for several Unit 1 licensing items resolved since Supplement 24 was issued.

3315 (NUREG/CP–0119-Vol.1, pp. 29-51) **Heavy-Section Steel Technology Program: Recent developments in crack initiation and arrest research.** Pennell, W.E. (Oak Ridge National Lab., TN (United States)). Nuclear Regulatory Commission, Washington, DC (United States). Office of Nuclear Regulatory Research; Brookhaven National Lab., Upton, NY (United States). Apr 1992. DOE Contract AC05-84OR21400. (CONF-911079–Vol.1: 19. Nuclear Regulatory Commission (NRC) water reactor safety information meeting, Bethesda, MD (United States), 28-30 Oct 1991). In *Proceedings of the US Nuclear Regulatory Commission nineteenth water reactor safety information meeting. Volume 1, Plenary session; Pressure vessel and piping integrity; Metallurgy and NDE; Aging and components; Probabilistic risk assessment topics.* 523p. Source: OSTI; NTIS; INIS; GPO.

Technology for the analysis of crack initiation and arrest is central to the reactor pressure vessel fracture-margin-assessment process. Regulatory procedures for nuclear plants utilize this technology to assure the retention of adequate fracture-prevention margins throughout the plant operating license period. As nuclear plants age and regulatory procedures dictate that fracture-margin assessments be performed, interest in the fracture-mechanics technology incorporated into those procedures has heightened. This has led to proposals from a number of sources for development and refinement of the underlying crack-initiation and arrest-analysis technology. This paper presents an overview of ongoing Heavy-Section Steel Technology (HSST) Program research aimed at refining the fracture toughness data used in the analysis of fracture margins under pressurized-thermal-shock loading conditions.

3316 (NUREG/CP–0119-Vol.1, pp. 53-72) **Pipe fracture behavior under high-rate (seismic) loading - The IPIRG program.** Schmidt, R.A. (Battelle, Columbus, OH (United States)); Wilkowski, G.M.; Scott, P.M.; Olson, R.J. Nuclear Regulatory Commission, Washington, DC (United States). Office of Nuclear Regulatory Research; Brookhaven National Lab., Upton, NY (United States). Apr 1992. (CONF-911079–Vol.1: 19. Nuclear Regulatory Commission (NRC) water reactor safety information meeting, Bethesda, MD (United States), 28-30 Oct 1991). In *Proceedings of the US Nuclear Regulatory Commission nineteenth water reactor safety information meeting. Volume 1, Plenary session; Pressure vessel and piping integrity; Metallurgy and NDE; Aging and components; Probabilistic risk assessment topics.* 523p. Source: OSTI; NTIS; INIS; GPO.

Results are summarized from numerous experiments and supporting analyses conducted to investigate the behavior of circumferentially flawed piping and piping systems subjected to high-rate loading typical of seismic events. The investigation included both 'separate effects' experiments on simple pipe specimens with either pure inertial or displacement-controlled loading, and full-scale experiments on a representative piping system with combined loading tested at pressurized water reactor (PWR) conditions.

3317 (NUREG/CP–0119-Vol.1, pp. 73-96) **Short cracks in piping and piping welds.** Wilkowski, G. (Battelle, Columbus, OH (United States)); Brust, F.; Francini, R.; Kilinski, T.; Krishnaswamy, P.; Landow, M.; Marschall, C.; Rahman, S.; Scott, P. Nuclear Regulatory Commission, Washington, DC (United States). Office of Nuclear Regulatory Research; Brookhaven National Lab., Upton, NY (United States). Apr 1992. (CONF-911079–Vol.1: 19. Nuclear Regulatory Commission (NRC) water reactor safety information meeting, Bethesda, MD (United States), 28-30 Oct 1991). In *Proceedings of the US Nuclear Regulatory Commission nineteenth water reactor safety information meeting. Volume 1, Plenary session; Pressure vessel and piping integrity; Metallurgy and NDE; Aging and components; Probabilistic risk assessment topics.* 523p. Source: OSTI; NTIS; INIS; GPO.

This program started on March 23, 1990, and has a duration of 4 years. The objective of the program is to develop and verify analyses by using existing and new experimental data for circumferentially cracked pipes, so modifications and improvements can be made to LBB and in-service flaw evaluation criteria. There are 7 technical tasks dealing, in general, with circumferentially cracked straight pipe under quasi-static loading. The tasks are as follows: short through wall cracked pipe evaluations, short surface-cracked pipe evaluations, bi-metallic cracked pipe evaluations, dynamic strain aging and crack jump evaluations, anisotropic fracture evaluations, crack-opening-area evaluations, and NRCPIPE code improvements. There is also a separate task to develop international cooperation, interact with Section 11 of the ASME code, and perform program management functions.

3318 (NUREG/CP–0119-Vol.1, pp. 97-126) **Heavy-Section Steel Irradiation Program: Embrittlement Issues.** Corwin, W.R. (Oak Ridge National Lab., TN (United States)). Nuclear Regulatory Commission, Washington, DC (United States). Office of Nuclear Regulatory Research; Brookhaven National Lab., Upton, NY (United States). Apr 1992. DOE Contract AC05-84OR21400. (CONF-911079–Vol.1: 19. Nuclear Regulatory Commission (NRC) water reactor safety information meeting, Bethesda, MD (United States), 28-30 Oct 1991). In *Proceedings of the US Nuclear Regulatory Commission nineteenth water reactor safety information meeting. Volume 1, Plenary session; Pressure vessel and piping integrity; Metallurgy and NDE; Aging and components; Probabilistic risk assessment topics.* 523p. Source: OSTI; NTIS; INIS; GPO.

Maintaining the integrity of the reactor pressure vessel (RPV) in a light-water-cooled nuclear power plant is crucial in preventing and controlling severe accidents and the potential for major contamination releases. It is imperative to understand and predict the capabilities and limitations of its integrity. It is particularly vital to fully understand the degree of irradiation-induced degradation of the RPV's fracture resistance which occurs during service, since without that radiation damage it is virtually impossible to postulate a realistic scenario which would result in RPV failure. The Heavy-Section Steel Irradiation (HSSI) Program has been established by the US Nuclear Regulatory Commission (USNRC) to provide a thorough, quantitative assessment of the effects of neutron irradiation on the material behavior, and in particular the fracture toughness properties, of typical pressure vessel steels as they relate to light-water reactor pressure-vessel integrity. Recent results are described concerning the shifts in fracture toughness and crack arrest toughness in high-copper welds, the effects of irradiation on stainless-steel weld-overlay cladding, the unirradiated examination of a low upper-shelf (LUS) weld from the Midland reactor, irradiation temperature effects on Charpy and tensile properties of several LUS welds, initial theoretical studies related to irradiation-rate effects, and the continued investigation into the causes of accelerated low-temperature embrittlement recently observed in RPV support steels.

3319 (NUREG/CP–0119-Vol.1, pp. 9-27) **Accomplishments and prospects.** Beckjord, E.S. Nuclear Regulatory Commission, Washington, DC (United States). Office of Nuclear Regulatory Research; Brookhaven National Lab., Upton, NY (United States). Apr 1992. (CONF-911079–Vol.1: 19. Nuclear Regulatory Commission (NRC) water reactor safety information meeting, Bethesda, MD (United States), 28-30 Oct 1991). In *Proceedings of the US Nuclear Regulatory Commission nineteenth water reactor safety information meeting. Volume 1, Plenary session; Pressure vessel and piping integrity; Metallurgy and NDE; Aging and components; Probabilistic risk assessment topics.* 523p. Source: OSTI; NTIS; INIS; GPO.

The author, director of the US Nuclear Regulatory Commission's (NRC) Office of Nuclear Regulatory Research, reviews some of the major accomplishments in NRC research in the past year and speaks about prospects for the coming year. The scope of research activities includes the following: integrity of reactor components, preventing damage to reactor cores, reactor containment performance, advanced reactor research, resolving safety issues

and developing regulations, and confirming the safety of waste disposal. Each of these areas of research are discussed as well as international cooperative activities.

3320 (NUREG/CP–0119-Vol.1, pp. 127-150) **Fatigue and environmentally assisted cracking in light water reactors.** Kassner, T.F. (Argonne National Lab., IL (United States)); Ruther, W.E.; Chung, H.M.; Hicks, P.D.; Hins, A.G.; Park, J.Y.; Shack, W.J. Nuclear Regulatory Commission, Washington, DC (United States). Office of Nuclear Regulatory Research; Brookhaven National Lab., Upton, NY (United States). Apr 1992. DOE Contract W-31109-ENG-38. (CONF-911079–Vol.1: 19. Nuclear Regulatory Commission (NRC) water reactor safety information meeting, Bethesda, MD (United States), 28-30 Oct 1991). In *Proceedings of the US Nuclear Regulatory Commission nineteenth water reactor safety information meeting. Volume 1, Plenary session; Pressure vessel and piping integrity; Metallurgy and NDE; Aging and components; Probabilistic risk assessment topics.* 523p. Source: OSTI; NTIS; INIS; GPO.

Fatigue and environmentally assisted cracking of piping, pressure vessels, and core components in light water reactors (LWRs) are important concerns as extended reactor lifetimes are envisaged. Topics that have been investigated during this year include fatigue and stress corrosion cracking (SCC) of low-alloy steel used in piping and in steam generator and reactor pressure vessels, role of chromate and sulfate in simulated boiling water reactor (BWR) water on SCC of sensitized Type 304 SS, and radiation-induced segregation (RIS) and irradiation-assisted SCC of Type 304 SS after accumulation of relatively high fluence. Fatigue data obtained on medium-sulfur-content A533-Gr B and A106-Gr B pressure-vessel and piping steels in high-purity (HP) deoxygenated water, in simulated pressurized water reactor (PWR) water, and in air all lie above the ASME design curve. Crack-growth-rate (CGR) measurements on composite specimens of A533-Gr B/Inconel-182/Inconel-600 and on homogeneous specimens of A533-Gr B material indicate that CGRs increased markedly during small-amplitude cyclic loading in HP water with ~ 300 ppb dissolved oxygen. Under cyclic loading, crack growth was observed at K_{max} values that produced no crack growth under constant loading. The CGR dependence on dissolved-oxygen concentration was also investigated under different loading conditions. Possible synergistic reactions involving chromate and sulfate in SCC of sensitized Type 304 SS have been investigated by fracture-mechanics CGR tests. Microchemical and microstructural changes in HP and commercial-purity Type 304 SS specimens from control-blade absorber tubes used in two operating BWRs were studied by Auger electron spectroscopy and scanning electron microscopy, and slow-strain-rate-tensile tests were conducted on tubular specimens in air and in simulated BWR water at 289C.

3321 (NUREG/CP–0119-Vol.1, pp. 151-178) **Estimation of mechanical properties of cast stainless steels during thermal aging in LWR systems.** Chopra, O.K. (Argonne National Lab., IL (United States)). Nuclear Regulatory Commission, Washington, DC (United States). Office of Nuclear Regulatory Research; Brookhaven National Lab., Upton, NY (United States). Apr 1992. DOE Contract W-31109-ENG-38. (CONF-911079–Vol.1: 19. Nuclear Regulatory Commission (NRC) water reactor safety information meeting, Bethesda, MD (United States), 28-30 Oct 1991). In *Proceedings of the US Nuclear Regulatory Commission nineteenth water reactor safety information meeting. Volume 1, Plenary session; Pressure vessel and piping integrity; Metallurgy and NDE; Aging and components; Probabilistic risk assessment topics.* 523p. Source: OSTI; NTIS; INIS; GPO.

A procedure and correlations are presented for predicting Charpy-impact energy, tensile flow stress, fracture toughness J-R curve, and J_{IC} of aged cast stainless steels from known material information. The saturation impact strength and fracture toughness of a specific cast stainless steel, i.e., the minimum value that would be achieved for the material after long-term service, is estimated from the chemical composition of the steel. Mechanical properties as a function of time and temperature of reactor service are estimated from impact energy and flow stress of the unaged material and the kinetics of embrittlement, which are also determined from chemical composition. The J_{IC} values are determined from the estimated J-R curve and flow stress. Examples of estimating mechanical properties of cast stainless steel components during reactor service are presented. A common 'predicted lower-bound' J-R curve for cast stainless steels of unknown chemical composition is also defined for a given grade of steel, ferrite content, and temperature.

3322 (NUREG/CP–0119-Vol.1, pp. 179-195) **Mechanical-property degradation of cast stainless steel components from the Shippingport reactor.** Chopra, O.K. (Argonne National Lab., IL (United States)). Nuclear Regulatory Commission, Washington, DC (United States). Office of Nuclear Regulatory Research; Brookhaven National Lab., Upton, NY (United States). Apr 1992. DOE Contract W-31109-ENG-38. (CONF-911079–Vol.1: 19. Nuclear Regulatory Commission (NRC) water reactor safety information meeting, Bethesda, MD (United States), 28-30 Oct 1991). In *Proceedings of the US Nuclear Regulatory Commission nineteenth water reactor safety information meeting. Volume 1, Plenary session; Pressure vessel and piping integrity; Metallurgy and NDE; Aging and components; Probabilistic risk assessment topics.* 523p. Source: OSTI; NTIS; INIS; GPO.

The mechanical properties of cast stainless steels from the Shippingport reactor have been characterized. Baseline properties for unaged materials were obtained from tests on either recovery-annealed material or material from a cooler region of the component. The materials exhibited modest decrease in impact energy and fracture toughness and a small increase in tensile strength. The fracture toughness J-R curve, J_{IC} value, tensile flow stress, and Charpy-impact energy of the materials showed very good agreement with estimations based on accelerated laboratory aging studies. The kinetics of thermal embrittlement and degree of embrittlement at saturation, i.e., the minimum impact energy that would be achieved after long-term aging, were established from materials that were aged further in the laboratory at temperatures between 320 and 400C. The results showed very good agreement with estimates; the activation energies ranged from 125 to 250 kJ/mole and the minimum room-temperature impact energy was > 75 J/cm^2. The estimated impact energy and fracture toughness J-R curve for materials from the Ringhals reactor hot and crossover-leg elbows are also presented.

3323 (NUREG/CP–0119-Vol.1, pp. 197-218) **Progress in evaluation and improvement in nondestructive examination reliability for inservice inspection of light water reactors (LWRs) and characterizing fabrication flaws in reactor pressure vessels.** Doctor, S.R. (Pacific Northwest Lab., Richland, WA (United States)); Andersen, E.S.; Bowey, R.E.; Diaz, A.A.; Friley, J.R.; Good, M.S.; Greenwood, M.S.; Heasler, P.G.; Hockey, R.L.; Kurtz, R.J.; Schuster, G.J.; Simonen, F.A.; Spanner, J.C.; Taylor, T.T.; VNuclear Regulatory Commission, Washington, DC (United States). Office of Nuclear Regulatory Research; Brookhaven National Lab., Upton, NY (United States). Apr 1992. DOE Contract AC06-76RL01830. (CONF-911079–Vol.1: 19. Nuclear Regulatory Commission (NRC) water reactor safety information meeting, Bethesda, MD (United States), 28-30 Oct 1991). In *Proceedings of the US Nuclear Regulatory Commission nineteenth water reactor safety information meeting. Volume 1, Plenary session; Pressure vessel and piping integrity; Metallurgy and NDE; Aging and components; Probabilistic risk assessment topics.* 523p. Source: OSTI; NTIS; INIS; GPO.

This paper is a review of the work conducted under two programs. One (NDE Reliability Program) is a multi-year program addressing the reliability of nondestructive evaluation (NDE) for the inservice inspection (ISI) of light water reactor components. This program examines the reliability of current NDE, the effectiveness of evolving technologies, and provides assessments and recommendations to ensure that the NDE is applied at the right time, in the right place with sufficient effectiveness that defects of importance to structural integrity will be reliably detected and accurately characterized. The second program (Characterizing Fabrication Flaws in Reactor Pressure Vessels) is assembling a data base to quantify the distribution of fabrication flaws that exist in US nuclear reactor pressure vessels with respect to density, size, type, and location. These programs are discussed as two separate sections in this report.

3324 (NUREG/CP–0119-Vol.1, pp. 219-233) **Validation and transfer of advanced NDE technologies.** Doctor, S.R. (Pacific Northwest Lab., Richland, WA (United States)); Hutton, P.H.; Bowey, R.E.; Kurtz, R.J.; Reid, L.D.; Schuster, G.J. Nuclear Regulatory Commission, Washington, DC (United States). Office of Nuclear Regulatory Research; Brookhaven National Lab., Upton, NY (United States). Apr 1992. DOE Contract AC06-76RL01830. (CONF-911079–Vol.1: 19. Nuclear Regulatory Commission (NRC) water reactor safety information meeting, Bethesda, MD (United States), 28-30 Oct 1991). In *Proceedings of the US Nuclear Regulatory Commission nineteenth water reactor safety information meeting. Volume 1, Plenary session; Pressure vessel and piping integrity; Metallurgy and NDE; Aging and components; Probabilistic risk assessment topics.* 523p. Source: OSTI; NTIS; INIS; GPO.

This paper reports on progress achieved under the Nuclear Regulatory Commission (NRC) program entitled Field Validation, Acceptance and Training for Advanced Nondestructive Testing (NDE) Technology. Work under this program in FY91 has concentrated on validation testing and the transfer of technologies previously developed under NRC supported programs. The objective of these efforts is to provide new beneficial NDE techniques which have been validated in their intended application mode on a reactor(s) and to transfer technologies to the nuclear industry. Program efforts are focused on acoustic emission (AE) for continuous monitoring and the synthetic aperture focusing technique for ultrasonic testing (SAFT-UT). These technologies will benefit nuclear plant regulation by providing timely indication of flaw initiation and growth as it occurs and the reliable detection of flaws with an accurate measure of the flaw size and shape.

3325 (NUREG/CP–0119-Vol.1, pp. 235-260) **Aging studies of 1E power and reactor protection systems, and transformers.** Edson, J.L. (Idaho National Engineering Lab., Idaho Falls (United States)); Sharma, V.; Roberts, E.W. Nuclear Regulatory Commission, Washington, DC (United States). Office of Nuclear Regulatory Research; Brookhaven National Lab., Upton, NY (United States). Apr 1992. DOE Contract AC07-76ID01570. (CONF-911079–Vol.1: 19. Nuclear Regulatory Commission (NRC) water reactor safety information meeting, Bethesda, MD (United States), 28-30 Oct 1991). In *Proceedings of the US Nuclear Regulatory Commission nineteenth water reactor safety information meeting. Volume 1, Plenary session; Pressure vessel and piping integrity; Metallurgy and NDE; Aging and components; Probabilistic risk assessment topics.* 523p. Source: OSTI; NTIS; INIS; GPO.

Previous 1E power and reactor protection system Phase 1 aging studies have shown that a significant percentage of failures are not being detected by planned inspection, surveillance and monitoring methods (IS and MM). This paper presents a Phase 2 study that was performed to determine the effectiveness of current IS and MM, identify the risk significant 1E power system components, and identify additional IS and MM that may effectively supplement current practices. In addition, a Phase 1 aging study of 1E power system transformers was performed to identify stressors and failure mechanisms, investigate whether transformers are showing signs of increased failure rates as they grow older, and to determine if current surveillance methods are effective in mitigating aging effects.

3326 (NUREG/CP–0119-Vol.1, pp. 261-273) **New method for detecting degradation in installed cables in nuclear power plants.** Kusama, Yasuo (Japan Atomic Energy Research Inst., Takasaki (Japan)); Yagi, Toshiaki; Morita, Yosuke; Kamimura, Seiji; Yagyu, Hideki. Nuclear Regulatory Commission, Washington, DC (United States). Office of Nuclear Regulatory Research; Brookhaven National Lab., Upton, NY (United States). Apr 1992. (CONF-911079–Vol.1: 19. Nuclear Regulatory Commission (NRC) water reactor safety information meeting, Bethesda, MD (United States), 28-30 Oct 1991). In *Proceedings of the US Nuclear Regulatory Commission nineteenth water reactor safety information meeting. Volume 1, Plenary session; Pressure vessel and piping integrity; Metallurgy and NDE; Aging and components; Probabilistic risk assessment topics.* 523p. Source: OSTI; NTIS; INIS; GPO.

The object of the investigation is to develop nondestructive detecting method for degradation of cables installed in nuclear power plants from the viewpoint of the safety operation and the life extension of the plants. Two kinds of detecting method (a) torque-strain response and (b) thermogravimetry were studied in order to apply to the low voltage cables, for which effective detecting methods have not been completed. Applicability of the methods to the low voltage CV cables (cross-linked polyethylene insulation, polyvinylchloride jacket) were discussed by using elongation at break as a primary standard.

3327 (NUREG/CP–0119-Vol.1, pp. 275-287) **Detecting and mitigating aging in component cooling water systems.** Lofaro, R.J. (Brookhaven National Lab., Upton, NY (United States)). Nuclear Regulatory Commission, Washington, DC (United States). Office of Nuclear Regulatory Research; Brookhaven National Lab., Upton, NY (United States). Apr 1992. (CONF-911079–Vol.1: 19. Nuclear Regulatory Commission (NRC) water reactor safety information meeting, Bethesda, MD (United States), 28-30 Oct 1991). In *Proceedings of the US Nuclear Regulatory Commission nineteenth water reactor safety information meeting. Volume 1, Plenary session; Pressure vessel and piping integrity; Metallurgy and NDE; Aging and components; Probabilistic risk assessment topics.* 523p. Source: OSTI; NTIS; INIS; GPO.

The time-dependent effects of aging on component cooling water (CCW) systems in nuclear power plants has been studied and documented as part of a research program sponsored by the US Nuclear Regulatory Commission. It was found that age related degradation leads to failures in the CCW system which can result in an increase in system unavailability, if not properly detected and mitigated. To identify effective methods of managing this degradation, information on inspection, monitoring, and maintenance practices currently available was obtained from various operating plants and reviewed. The findings were correlated with the most common aging mechanisms and failure modes, and a compilation of aging detection and mitigation practices was formulated. This paper discusses the results of this work.

3328 (NUREG/CP–0119-Vol.1, pp. 289-306) **The effects of aging on friction of MOVs.** Hunt, T.H. (Idaho National Engineering Lab., Idaho Falls (United States)); Sinha, U.P. Nuclear Regulatory Commission, Washington, DC (United States). Office of Nuclear Regulatory Research; Brookhaven National Lab., Upton, NY (United States). Apr 1992. DOE Contract AC07-76ID01570. (CONF-911079–Vol.1: 19. Nuclear Regulatory Commission (NRC) water reactor safety information meeting, Bethesda, MD (United States), 28-30 Oct 1991). In *Proceedings of the US Nuclear Regulatory Commission nineteenth water reactor safety information meeting. Volume 1, Plenary session; Pressure vessel and piping integrity; Metallurgy and NDE; Aging and components; Probabilistic risk assessment topics.* 523p. Source: OSTI; NTIS; INIS; GPO.

As part of the Nuclear Regulatory Commission's Nuclear Plant Aging Research Program, the Idaho National Engineering Laboratory studied aging mechanisms affecting the friction coefficients of motor-operated valves (MOVs). The study reviewed current corrosion theory and MOV operating history data, observed in-service MOV conditions, and discussed valve operability failures with engineering and maintenance personnel to determine the effects of corrosion, erosion, and oxide deposition on valve sliding surface friction coefficients. This paper reports an overview of the study's methodology and results.

3329 (NUREG/CP–0119-Vol.1, pp. 307-329) **NRC test results and operations experience provide insights for a new gate valve stem force correlation.** Watkins, J.C. (Idaho National Engineering Lab., Idaho Falls (United States)); Steele, R.; DeWall, K.G. Nuclear Regulatory Commission, Washington, DC (United States). Office of Nuclear Regulatory Research; Brookhaven National Lab., Upton, NY (United States). Apr 1992. DOE Contract AC07-76ID01570. (CONF-911079–Vol.1: 19. Nuclear Regulatory Commission (NRC) water reactor safety information meeting, Bethesda, MD (United States), 28-30 Oct 1991). In *Proceedings of the US Nuclear Regulatory Commission nineteenth water reactor safety information meeting. Volume 1, Plenary session; Pressure vessel and piping integrity; Metallurgy and NDE; Aging and components; Probabilistic risk assessment topics.* 523p. Source: OSTI; NTIS; INIS; GPO.

The Idaho National Engineering Laboratory (INEL) is performing motor-operated valve (MOV) research in support of the US Nuclear Regulatory Commission's (NRC's) efforts regarding Generic Issue

87, 'Failure of HPCI (High-Pressure Coolant Injection) Steam Line Without Isolation,' and Generic Letter 89-10 (GL 89-10), 'Safety-Related Motor-Operated Valve Testing and Surveillance.' This paper presents the results of testing to assess valve and motor operator performance under varying pressures and fluid conditions. This effort included an examination of the methods used by the industry for predicting required valve thrusts and research to provide guidelines for the extrapolation of in situ test results to design basis conditions. This research has identified several inconsistencies in the existing industry stem thrust equation and challenged the overly simplistic assumptions inherent in the use of the equation. This paper discusses development of a new equation whereby conservative stem thrust estimates can be calculated for some flexwedge gate valves, that is, those classes of valves whose operational characteristics have been shown to be predictable. The authors also present a method whereby the results of testing of such valves at low differential pressure can be used to estimate valve response at up to design basis conditions.

3330 (NUREG/CP–0119-Vol.1, pp. 331-342) **Applications and extensions of degradation modeling.** Hsu, F. (Brookhaven National Lab., Upton, NY (United States)); Subudhi, M.; Samanta, P.K.; Vesely, W.E. Nuclear Regulatory Commission, Washington, DC (United States). Office of Nuclear Regulatory Research; Brookhaven National Lab., Upton, NY (United States). Apr 1992. (CONF-911079–Vol.1: 19. Nuclear Regulatory Commission (NRC) water reactor safety information meeting, Bethesda, MD (United States), 28-30 Oct 1991). In *Proceedings of the US Nuclear Regulatory Commission nineteenth water reactor safety information meeting. Volume 1, Plenary session; Pressure vessel and piping integrity; Metallurgy and NDE; Aging and components; Probabilistic risk assessment topics.* 523p. Source: OSTI; NTIS; INIS; GPO.

Component degradation modeling being developed to understand the aging process can have many applications with potential advantages. Previous work has focused on developing the basic concepts and mathematical development of a simple degradation model. Using this simple model, times of degradations and failures occurrences were analyzed for standby components to detect indications of aging and to infer the effectiveness of maintenance in preventing age-related degradations from transforming to failures. Degradation modeling approaches can have broader applications in aging studies and in this paper, the authors discuss some of the extensions and applications of degradation modeling. The extensions and applications of the degradation modeling approaches discussed are: (a) theoretical developments to study reliability effects of different maintenance strategies and policies, (b) relating aging-failure rate to degradation rate, and (c) application to a continuously operating component.

3331 (NUREG/CP–0119-Vol.1, pp. 343-361) **Aging assessment of BWR control rod drive systems.** Greene, R.H. (Oak Ridge National Lab., TN (United States)). Nuclear Regulatory Commission, Washington, DC (United States). Office of Nuclear Regulatory Research; Brookhaven National Lab., Upton, NY (United States). Apr 1992. DOE Contract AC05-84OR21400. (CONF-911079–Vol.1: 19. Nuclear Regulatory Commission (NRC) water reactor safety information meeting, Bethesda, MD (United States), 28-30 Oct 1991). In *Proceedings of the US Nuclear Regulatory Commission nineteenth water reactor safety information meeting. Volume 1, Plenary session; Pressure vessel and piping integrity; Metallurgy and NDE; Aging and components; Probabilistic risk assessment topics.* 523p. Source: OSTI; NTIS; INIS; GPO.

This Phase 1 Nuclear Plant Aging Research (NPAR) study examines the aging phenomena associated with boiling water reactor (BWR) control rod drive mechanisms (CRDMs) and assesses the merits of various methods of managing this aging. Information for this study was acquired from (1) the results of a special CRDM aging questionnaire distributed to each US BWR utility, (2) a first-of-its-kind workshop held to discuss CRDM aging and maintenance concerns, (3) an analysis of NPRDS failure cases attributed to the CRD system, and (4) personal information exchange. As part of this study, nearly 3,500 NPRDS failure reports have been analyzed to examine the prevailing failure trends for CRD system components. An investigation has been conducted that summarizes the occurrence frequency of these component failures, discovery methods, reported failure causes, their respective symptoms, and actions taken by utilities to restore component and system service. The results of this research have identified the predominant CRDM failure modes and causes. In addition, recommendations are presented regarding specific actions that utilities can implement to mitigate CRDM aging. An evaluation has also been made of certain practices and tooling which have enabled some utilities to reduce ALARA exposures received from routine CRDM replacement and rebuilding activities.

3332 (NUREG/CP–0119-Vol.1, pp. 363-373) **The effect of aging upon CE and B and W control rod drives.** Grove, E. (Brookhaven National Lab., Upton, NY (United States)); Gunther, W. Nuclear Regulatory Commission, Washington, DC (United States). Office of Nuclear Regulatory Research; Brookhaven National Lab., Upton, NY (United States). Apr 1992. (CONF-911079–Vol.1: 19. Nuclear Regulatory Commission (NRC) water reactor safety information meeting, Bethesda, MD (United States), 28-30 Oct 1991). In *Proceedings of the US Nuclear Regulatory Commission nineteenth water reactor safety information meeting. Volume 1, Plenary session; Pressure vessel and piping integrity; Metallurgy and NDE; Aging and components; Probabilistic risk assessment topics.* 523p. Source: OSTI; NTIS; INIS; GPO.

The effect of aging upon the Babcock and Wilcox and Combustion Engineering control rod drive systems has been evaluated as part of the US Nuclear Regulatory Commission Nuclear Plant Aging Research program. Operating experience data for the 1980-1990 time period was reviewed to identify predominant failure modes, causes, and effects. These results, in conjunction with an assessment of component materials and operating environments, conclude that both systems are susceptible to age degradation. System failures have resulted in significant plant effects, including power reductions, plant shutdowns, scrams, and engineered safety feature actuation. Current industry inspection and maintenance practices were assessed. Some of these practices effectively address aging, while others do not.

3333 (NUREG/CP–0119-Vol.1, pp. 375-381) **Aging related degradation in turbine drives and governors for safety related pumps.** Cox, D.F. (Oak Ridge National Lab., TN (United States)). Nuclear Regulatory Commission, Washington, DC (United States). Office of Nuclear Regulatory Research; Brookhaven National Lab., Upton, NY (United States). Apr 1992. DOE Contract AC05-84OR21400. (CONF-911079–Vol.1: 19. Nuclear Regulatory Commission (NRC) water reactor safety information meeting, Bethesda, MD (United States), 28-30 Oct 1991). In *Proceedings of the US Nuclear Regulatory Commission nineteenth water reactor safety information meeting. Volume 1, Plenary session; Pressure vessel and piping integrity; Metallurgy and NDE; Aging and components; Probabilistic risk assessment topics.* 523p. Source: OSTI; NTIS; INIS; GPO.

This study is being performed to examine the relationship between time dependent degradation, and current industry practices in the areas of maintenance, surveillance, and operation of steam turbine drives for safety related pumps. These pumps are located in the auxiliary feedwater (AFW) system for pressurized water reactor (PWR) plants, and the reactor core isolation cooling (RCIC) and high pressure coolant injection (HPCI) systems for boiling water reactor (BWR) facilities. This research has been conducted by examining current information in NPRDS, reviewing licensee event reports, and thoroughly investigating contacts with operating plant personnel, and by personal observation. The reported information was reviewed to determine the cause of the event and the method of discovery. From this data attempts have been made at determining the predictability of events and possible preventive measures that may be implemented. Findings in a recent study on the auxiliary feedwater system (NUREG/CR-5404) indicate that the turbine drive is the single largest contributor to AFW system degradation. Examination of the data, however, show that the turbine itself is a reliable piece of equipment with a good service record. Most of the documented failures are the result of problems with the turbine controls and the mechanical overspeed trip mechanism, which apparently stem from three major causes identified in the paper. Recent improvements in maintenance practices and procedures,

combined with a stabilization of the design seem to indicate that this equipment can be a reliable component in safety systems.

3334 (NUREG/CP–0119-Vol.1, pp. 383-398) **Aging, condition monitoring, and loss-of-coolant accident (LOCA) tests of Class 1E electrical cables: Summary of results.** Jacobus, M.J. (Sandia National Labs., Albuquerque, NM (United States)). Nuclear Regulatory Commission, Washington, DC (United States). Office of Nuclear Regulatory Research; Brookhaven National Lab., Upton, NY (United States). Apr 1992. DOE Contract AC04-76DP00789. (CONF-911079–Vol.1: 19. Nuclear Regulatory Commission (NRC) water reactor safety information meeting, Bethesda, MD (United States), 28-30 Oct 1991). In *Proceedings of the US Nuclear Regulatory Commission nineteenth water reactor safety information meeting. Volume 1, Plenary session; Pressure vessel and piping integrity; Metallurgy and NDE; Aging and components; Probabilistic risk assessment topics.* 523p. Source: OSTI; NTIS; INIS; GPO.

This paper summarizes the results of aging, condition monitoring, and accident testing of Class 1E cables used in nuclear power generating stations. Three sets of cables were aged for up to 9 months under simultaneous thermal ($\simeq$ 100C) and radiation ($\simeq$ 0.10 kGy/hr) conditions. After the aging, the cables were exposed to a simulated accident consisting of high dose rate irradiation ($\simeq$ 6 kGy/hr) followed by a high temperature steam exposure. A fourth set of cables, which were unaged, were also exposed to the accident conditions. The cables that were aged for 3 months and then accident tested were subsequently exposed to a high temperature steam fragility test (up to 400C), while the cables that were aged for 6 months and then accident tested were subsequently exposed to a 1,000-hour submergence test in a chemical solution. The results of the tests indicate that the feasibility of life extension of many popular nuclear power plant cable products is promising and that mechanical measurements (primarily elongation, modulus, and density) were more effective than electrical measurements for monitoring age-related degradation. In the high temperature steam test, ethylene propylene rubber (EPR) cable materials generally survived to higher temperatures than crosslinked polyolefin (XLPO) cable materials. In dielectric testing after the submergence testing, the XLPO materials performed better than the EPR materials. This paper presents some recent experimental data that are not yet available elsewhere and a summary of findings from the entire experimental program.

3335 (NUREG/CP–0119-Vol.1, pp. 399-417) **Effects of aging on calibration and response time of nuclear plant pressure transmitters.** Hashemian, H.M. (Analysis and Measurement Services Corp., Knoxville, TN (United States)). Nuclear Regulatory Commission, Washington, DC (United States). Office of Nuclear Regulatory Research; Brookhaven National Lab., Upton, NY (United States). Apr 1992. (CONF-911079–Vol.1: 19. Nuclear Regulatory Commission (NRC) water reactor safety information meeting, Bethesda, MD (United States), 28-30 Oct 1991). In *Proceedings of the US Nuclear Regulatory Commission nineteenth water reactor safety information meeting. Volume 1, Plenary session; Pressure vessel and piping integrity; Metallurgy and NDE; Aging and components; Probabilistic risk assessment topics.* 523p. Source: OSTI; NTIS; INIS; GPO.

This paper reports on a comprehensive research project being conducted for the Nuclear Regulatory Commission to quantify the effects of normal aging on calibration and response time of nuclear plant pressure, level, and flow transmitters (hereafter referred to as pressure transmitters). The project involved laboratory testing and analysis of typical pressure transmitters of the types used for safety-related pressure measurements in nuclear power plants. The transmitters were aged in simulated reactor conditions and their response time and calibration were tested periodically to determine their long term performance characteristics. Normal aging was emphasized as opposed to accelerated aging. The project involved research in six areas as follows: aging tests of complete transmitter assembly, aging of critical components of transmitters, clogging of pressure sensing lines, oil loss phenomenon in Rosemount and other transmitters, evaluation of methods for on-line testing of pressure transmitters, and analysis of licensee event report and Nuclear Plant Reliability Data System databases for failures of pressure sensing systems in nuclear power plants. The above research areas are individually discussed in the paper and their key results are presented.

3336 (NUREG/CP–0119-Vol.1, pp. 419-428) **Snubber aging assessment: Results of NPAR Phase 2 in-plant research.** Blahnik, D.E. (Pacific Northwest Lab., Richland, WA (United States)); Werry, E.V.; Brown, D.P. Nuclear Regulatory Commission, Washington, DC (United States). Office of Nuclear Regulatory Research; Brookhaven National Lab., Upton, NY (United States). Apr 1992. DOE Contract AC06-76RL01830. (CONF-911079–Vol.1: 19. Nuclear Regulatory Commission (NRC) water reactor safety information meeting, Bethesda, MD (United States), 28-30 Oct 1991). In *Proceedings of the US Nuclear Regulatory Commission nineteenth water reactor safety information meeting. Volume 1, Plenary session; Pressure vessel and piping integrity; Metallurgy and NDE; Aging and components; Probabilistic risk assessment topics.* 523p. Source: OSTI; NTIS; INIS; GPO.

Snubbers are safety-related devices used to restrain undesirable dynamic loads at various piping and large equipment locations in nuclear power plants. Each snubber must accommodate a plant's normal thermal movements and be capable of restraining the maximum off-normal dynamic loads postulated for its specific location. Snubbers are subject to the effects of aging, and the factors that degrade their safety performance need to be better understood. This paper describes the in-plant aging research conducted to enhance the understanding of snubber aging and its consequences. The research methodology, results, conclusions, and recommendations are described in the paper. Recommendations for monitoring the service life of snubbers is a principal result of the research and will provide input to the American Society of Mechanical Engineers Operations and Maintenance Code.

3337 (NUREG/CP–0119-Vol.1, pp. 429-434) **Preliminary results of the PWR low power and shutdown accident frequencies program - Coarse screening analysis for Surry.** Chu, T.L. (Brookhaven National Lab., Upton, NY (United States)); Musicki, Z.; Luckas, W.; Wong, S.M.; Neymotin, L.; Diamond, D.J.; Hsu, C.J.; Bozoki, G.; Kohut, P.; Fitzpatrick, R.; Siu, N. Nuclear Regulatory Commission, Washington, DC (United States). Office of Nuclear Regulatory Research; Brookhaven National Lab., Upton, NY (United States). Apr 1992. (CONF-911079–Vol.1: 19. Nuclear Regulatory Commission (NRC) water reactor safety information meeting, Bethesda, MD (United States), 28-30 Oct 1991). In *Proceedings of the US Nuclear Regulatory Commission nineteenth water reactor safety information meeting. Volume 1, Plenary session; Pressure vessel and piping integrity; Metallurgy and NDE; Aging and components; Probabilistic risk assessment topics.* 523p. Source: OSTI; NTIS; INIS; GPO.

This document presents the preliminary internal events Level 1 results (including fire and flood) obtained as a result of a coarse screening analysis on the low power and shutdown accident frequencies of the Surry Nuclear Power Plant. The work was performed by Brookhaven National Laboratory for the Nuclear Regulatory Commission (NRC) Office of Nuclear Regulatory Research (RES). This coarse screening analysis was performed in support of the NRC staff's follow-up actions subsequent to the March 20, 1990 Vogtle incident with the objective of providing high-level qualitative insights within a relatively short time frame. It is the first phase of a major study that will ultimately produce estimates on the core damage frequency of a pressurized water reactor during low power and shutdown conditions. Phase 2 of the study will be guided by the Phase 1 results in order to concentrate the effort on the various plant operational states, the dominant accident sequences, and pertinent data items according to their importance to core damage frequency and risk.

3338 (NUREG/CP–0119-Vol.1, pp. 435-448) **Status of the low power and shutdown accident sequence analysis project for the Grand Gulf Nuclear Power Station.** Whitehead, D.W. (Sandia National Labs., Albuquerque, NM (United States)); Staple, B.D.; Brown, T.D.; Darby, J.; Walsh, B. Nuclear Regulatory Commission, Washington, DC (United States). Office of Nuclear Regulatory Research; Brookhaven National Lab., Upton, NY (United States). Apr 1992. DOE Contract AC04-76DP00789. (CONF-911079–Vol.1: 19. Nuclear Regulatory Commission (NRC) water reactor safety information meeting, Bethesda, MD (United

States), 28-30 Oct 1991). In *Proceedings of the US Nuclear Regulatory Commission nineteenth water reactor safety information meeting. Volume 1, Plenary session; Pressure vessel and piping integrity; Metallurgy and NDE; Aging and components; Probabilistic risk assessment topics.* 523p. Source: OSTI; NTIS; INIS; GPO.

This paper describes the current status of Phases 1 and 1A of the BWR Low Power and Shutdown Accident Frequencies Program being conducted at Sandia National Laboratories for the US Nuclear Regulatory Commission. The major focus of the project to date has been the identification and coarse screening quantification of accident sequences initiated in modes of operation other than full power. The coarse screening provides a filtering mechanism whereby the potentially important accident sequences are identified. The information obtained during these two phases will be used to prioritize the more detailed analyses which will occur during Phase 2 of the project. A summarization of the project including results and insights from Phases 1 and 1A is presented.

3339 (NUREG/CP–0119-Vol.1, pp. 449-471) **Integrated Level 3 risk assessment for the LaSalle Unit 2 Nuclear Power Plant.** Payne, A.C. Jr. (Sandia National Labs., Albuquerque, NM (United States)); Brown, T.D.; Miller, L.A. Nuclear Regulatory Commission, Washington, DC (United States). Office of Nuclear Regulatory Research; Brookhaven National Lab., Upton, NY (United States). Apr 1992. DOE Contract AC04-76DP00789. (CONF-911079–Vol.1: 19. Nuclear Regulatory Commission (NRC) water reactor safety information meeting, Bethesda, MD (United States), 28-30 Oct 1991). In *Proceedings of the US Nuclear Regulatory Commission nineteenth water reactor safety information meeting. Volume 1, Plenary session; Pressure vessel and piping integrity; Metallurgy and NDE; Aging and components; Probabilistic risk assessment topics.* 523p. Source: OSTI; NTIS; INIS; GPO.

In this paper the authors discuss the methodology and results of the integrated Level 3 Probabilistic Risk Assessment (PRA) of the LaSalle County Station Unit 2 Nuclear Power Plant. Methods were developed for integrating internal and external events into one analysis based on a common model of the plant and a common method for representing the output. Additional methods were developed for representing and propagating uncertainties in the basic inputs to the models to determine their effects on the final (or intermediate) results. The integrated core damage frequency for the LaSalle plant is 1.01E-4/R-yr., with a 5th percentile of 5.34E-6/R-yr., a median value of 2.92E-5/R-yr., and a 95th percentile of 2.93E-4/R-yr. The dominant sequence is short-term station blackout. The risk from the LaSalle plant is low, especially with respect to the NRC safety goals. The mean individual early fatality risk within one mile and the mean individual latent cancer risk are 1.1E-10/R-yr and 8.5E-9/R-yr, respectively; both of which are several orders of magnitude less than the safety goals.

3340 (NUREG/CP–0119-Vol.1, pp. 473-480) **Risk-based performance indicators.** Azarm, M.A. (Brookhaven National Lab., Upton, NY (United States)); Vesely, W.E. Nuclear Regulatory Commission, Washington, DC (United States). Office of Nuclear Regulatory Research; Brookhaven National Lab., Upton, NY (United States). Apr 1992. (CONF-911079–Vol.1: 19. Nuclear Regulatory Commission (NRC) water reactor safety information meeting, Bethesda, MD (United States), 28-30 Oct 1991). In *Proceedings of the US Nuclear Regulatory Commission nineteenth water reactor safety information meeting. Volume 1, Plenary session; Pressure vessel and piping integrity; Metallurgy and NDE; Aging and components; Probabilistic risk assessment topics.* 523p. Source: OSTI; NTIS; INIS; GPO.

This research was sponsored by the Nuclear Regulatory Commission (NRC) to develop methods for monitoring an aspect of safety performance of licensed nuclear power plants; i.e., unavailability of safety systems. Various options were evaluated for constructing system unavailability indicators using basic reliability principles and consistent with the content of data collected. The capabilities of each indicator option, in terms of detection probabilities and false alarm rates within a fixed response period for various types of anomalies, were evaluated through detailed simulation studies. Brookhaven National Laboratory performed two studies to evaluate the capability of NPRDS (Nuclear Plant Reliability Data System) as a data source for construction of system unavailability indicators. Specific indicators were developed consistent with the limited scope of NPRDS data. In order to generate system unavailability indicators in an efficient manner, the processes for NPRDS data acquisition, indicator construction, and analyses were automated using personal computer software. Limited pilot applications and verification were also performed.

3341 (NUREG/CP–0119-Vol.1, pp. 481-503) **Intersystem LOCA risk assessment: Methodology and results.** Galyean, W.J. (Idaho National Engineering Lab., Idaho Falls (United States)); Kelly, D.L.; Schroeder, J.A.; Auflick, J.L.; Blackman, H.S.; Gertman, D.I.; Haney, L.N. Nuclear Regulatory Commission, Washington, DC (United States). Office of Nuclear Regulatory Research; Brookhaven National Lab., Upton, NY (United States). Apr 1992. (CONF-911079–Vol.1: 19. Nuclear Regulatory Commission (NRC) water reactor safety information meeting, Bethesda, MD (United States), 28-30 Oct 1991). In *Proceedings of the US Nuclear Regulatory Commission nineteenth water reactor safety information meeting. Volume 1, Plenary session; Pressure vessel and piping integrity; Metallurgy and NDE; Aging and components; Probabilistic risk assessment topics.* 523p. Source: OSTI; NTIS; INIS; GPO.

The United States Nuclear Regulatory Commission is sponsoring a research program to develop an improved understanding of the human factors, hardware, and accident consequence issues that dominate the risk from an Intersystem Loss-of-Coolant Accident (ISLOCA) at a nuclear power plant. To accomplish the goals of this program, a methodology has been developed for estimating ISLOCA core damage frequency and risk. The steps in this methodology are briefly described, along with the results obtained from an application of the methodology at three pressurized water reactors.

3342 (NUREG/CP–0119-Vol.2, pp. 27-31) **MELCOR peer review.** Boyack, B.E. (Los Alamos National Lab., NM (United States)); Dhir, V.K.; Gieseke, J.A.; Haste, T.J.; Kenton, M.A.; Khatib-Rahbar, M.; Leonard, M.T.; Viskanta, R. Nuclear Regulatory Commission, Washington, DC (United States). Office of Nuclear Regulatory Research; Brookhaven National Lab., Upton, NY (United States). Apr 1992. (CONF-911079–Vol.2: 19. Nuclear Regulatory Commission (NRC) water reactor safety information meeting, Bethesda, MD (United States), 28-30 Oct 1991). In *Proceedings of the US Nuclear Regulatory Commission nineteenth water reactor safety information meeting. Volume 2, Severe accident research; Severe accident policy implementation; Accident management.* 504p. Source: OSTI; NTIS; INIS; GPO.

MELCOR is a fully integrated, engineering-level computer code that models the progression of severe accidents in light water reactor nuclear power plants. The newest version of MELCOR is Version 1.8.1, July, 1991. MELCOR development has reached the point that the United States Nuclear Regulatory Commission sponsored a broad technical review by recognized experts to determine or confirm the technical adequacy of the code for the serious and complex analyses it is expected to perform. For this purpose, an eight-member MELCOR Peer Review Committee was organized. The Committee has completed its review of the MELCOR code; the review process and findings of the MELCOR Peer Review Committee are documented in a summary report to be issued soon. The Committee has determined that recommendations in five areas are appropriate: (1) MELCOR numerics, (2) models missing from MELCOR Version 1.8.1, (3) existing MELCOR models needing revision, (4) the need for expanded MELCOR assessment, and (5) documentation.

3343 (NUREG/CP–0119-Vol.2, pp. 33-48) **Planned MELCOR improvements and assessment.** Summers, R.M. (Sandia National Labs., Albuquerque, NM (United States)); Kmetyk, L.N. Nuclear Regulatory Commission, Washington, DC (United States). Office of Nuclear Regulatory Research; Brookhaven National Lab., Upton, NY (United States). Apr 1992. DOE Contract AC04-76DP00789. (CONF-911079–Vol.2: 19. Nuclear Regulatory Commission (NRC) water reactor safety information meeting, Bethesda, MD (United States), 28-30 Oct 1991). In *Proceedings of the US Nuclear Regulatory Commission nineteenth water reactor safety information meeting. Volume 2, Severe accident research; Severe accident policy implementation; Accident management.* 504p. Source: OSTI; NTIS; INIS; GPO.

Although MELCOR is now being successfully applied in severe accident analyses, it is not yet complete and additional development and assessment is needed before MELCOR can fully satisfy its design objectives and be applied with confidence to its targeted applications. A number of current and planned improvements and assessment activities necessary to reach that stage are described in this paper. Modifications that have been implemented in the latest release of the code, version 1.8.1, are summarized, the status of work in progress on new models such as direct containment heating, in-vessel natural circulation, and materials interactions is given, and several additional models and other enhancements planned for the near future are described. The results of recent assessment calculations performed at Sandia National Laboratories are summarized, and assessment efforts that have just begun or are planned for the near future are briefly mentioned.

3344 (NUREG/CP–0119-Vol.2, pp. 49-73) **New containment modeling features of the CONTAIN code.** Murata, K.K. (Sandia National Labs., Albuquerque, NM (United States)); Williams, D.C.; Gido, R.G.; Griffith, R.O.; Washington, K.E.; Louie, D.Y.L. Nuclear Regulatory Commission, Washington, DC (United States). Office of Nuclear Regulatory Research; Brookhaven National Lab., Upton, NY (United States). Apr 1992. DOE Contract AC04-76DP00789. (CONF-911079–Vol.2: 19. Nuclear Regulatory Commission (NRC) water reactor safety information meeting, Bethesda, MD (United States), 28-30 Oct 1991). In *Proceedings of the US Nuclear Regulatory Commission nineteenth water reactor safety information meeting. Volume 2, Severe accident research; Severe accident policy implementation; Accident management.* 504p. Source: OSTI; NTIS; INIS; GPO.

Two revisions of the CONTAIN code, CONTAIN 1.11 and 1.12, have recently been released. The purpose of this paper is to highlight the new features of these revisions and to discuss other new code features currently under development. The features of CONTAIN 1.11 discussed here include a quasi-mechanistic concrete outgassing model, the connected structure option for heat conduction between compartments, and a new approach for modeling forced convective heat transfer. The direct containment heating (DCH) models released as part of CONTAIN 1.12 are also discussed. New code features currently under development include a revised gas combustion model and a new multifield DCH model. New features of the revised combustion model include the treatment of spontaneous recombination and diffusion flames. CONTAIN plant calculations comparing the old and the revised combustion models are presented. The new features of the multifield DCH model are discussed, and demonstration calculations using this model to analyze a small scale experiment are presented.

3345 (NUREG/CP–0119-Vol.2, pp. 75-98) **CORA experiments on the materials behavior of LWR fuel rod bundles at high temperatures.** Hofmann, P. (Kernforschungszentrum Karlsruhe (Germany)); Schanz, G.; Hagen, S.; Sepold, L.; Schumacher, G. Nuclear Regulatory Commission, Washington, DC (United States). Office of Nuclear Regulatory Research; Brookhaven National Lab., Upton, NY (United States). Apr 1992. (CONF-911079–Vol.2: 19. Nuclear Regulatory Commission (NRC) water reactor safety information meeting, Bethesda, MD (United States), 28-30 Oct 1991). In *Proceedings of the US Nuclear Regulatory Commission nineteenth water reactor safety information meeting. Volume 2, Severe accident research; Severe accident policy implementation; Accident management.* 504p. Source: OSTI; NTIS; INIS; GPO.

The chemical interactions that may occur in a fuel rod bundle with increasing temperature up to the complete melting of the components are described. The materials behavior of boiling water reactor (BWR) and pressurized water reactor (PWR) fuel rod bundles has been studied in integral experiments (CORA program) and extensive separate-effects tests. The kinetic results of the most important chemical interactions are represented. In most cases the reaction products have lower melting points or ranges than the original components. This results in a relocation of liquefied components, often far below their melting points. In addition, the influence of thin oxide layers, which form on Zircaloy surfaces during normal reactor operation on the chemical interactions is given. As a result of the various studies three distinct temperature regimes can be defined in which liquid phases form in the fuel rod bundles in different large quantities. Their influence on damage progression and on possible accident management measures to avoid an uncontrolled core melt down accident are described.

3346 (NUREG/CP–0119-Vol.2, pp. 99-112) **Boiling jet modeling on IFCI - Preliminary report.** Rightley, M.J. (Sandia National Labs., Albuquerque, NM (United States)). Nuclear Regulatory Commission, Washington, DC (United States). Office of Nuclear Regulatory Research; Brookhaven National Lab., Upton, NY (United States). Apr 1992. (CONF-911079–Vol.2: 19. Nuclear Regulatory Commission (NRC) water reactor safety information meeting, Bethesda, MD (United States), 28-30 Oct 1991). In *Proceedings of the US Nuclear Regulatory Commission nineteenth water reactor safety information meeting. Volume 2, Severe accident research; Severe accident policy implementation; Accident management.* 504p. Source: OSTI; NTIS; INIS; GPO.

Simulations of the breakup and penetration of high temperature thermite jets into water have been performed using the integrated fuel-coolant interaction code, IFCI. The work to date has been directed towards assessing the model performance against data obtained from an experimental test series performed at Sandia. The tests, part of the EJET series, were extensively photographed to allow for direct digitization of the melt profile data thereby allowing a direct comparison of the IFCI predictions to the test data. This document is a preliminary report for Task 1, Molten Jet Model Evaluation, of the Molten Fuel-Coolant Interaction Program. The IFCI simulation of test EJET-1, with initially saturated water, showed reasonable performance in predicting early time leading edge penetration rate and initial jet spreading as shown by comparisons of the molten thermite volume fraction. A transition to a bulk boiling temperature regime which was observed in both tests was not modeled adequately by IFCI. An attempt to simulate test EJET-0, with initially subcooled water, failed at very early times due to an automatic decrease in the time step to an unacceptable value caused by nonconvergence of the numerical algorithm. The preliminary assessment results suggest (1) the need to include the steam volume fraction in the data comparisons, (2) an improvement of the boiling model in IFCI to address the bulk boiling question, and (3) use of a finer noding scheme to improve the spatial resolution of IFCI before the code is applied to addressing accident management concerns at reactor scale.

3347 (NUREG/CP–0119-Vol.2, pp. 113-127) **Adiabatic equilibrium models for direct containment heating.** Pilch, M.M. (Sandia National Labs., Albuquerque, NM (United States)). Nuclear Regulatory Commission, Washington, DC (United States). Office of Nuclear Regulatory Research; Brookhaven National Lab., Upton, NY (United States). Apr 1992. (CONF-911079–Vol.2: 19. Nuclear Regulatory Commission (NRC) water reactor safety information meeting, Bethesda, MD (United States), 28-30 Oct 1991). In *Proceedings of the US Nuclear Regulatory Commission nineteenth water reactor safety information meeting. Volume 2, Severe accident research; Severe accident policy implementation; Accident management.* 504p. Source: OSTI; NTIS; INIS; GPO.

Probabilistic risk assessment (PRA) studies are being extended to include a wider spectrum of reactor plants than was considered in NUREG-1150. There is a need for simple direct containment heating (DCH) models that can be used for screening studies aimed at identifying potentially significant contributors to overall risk in individual nuclear power plants. This paper presents two adiabatic equilibrium models suitable for the task. The first, a single-cell model, places a true upper bound on DCH loads. This upper bound, however, often far exceeds reasonable expectations of containment loads based on CONTAIN calculations and experiment observations. In this paper, a two cell model is developed that captures the major mitigating feature of containment compartmentalization, thus providing more reasonable estimates of the containment load. Predictions of the equilibrium models are compared with experimental data from the Limited Flight Path test series conducted at Sandia National Laboratories.

3348 (NUREG/CP–0119-Vol.2, pp. 129-138) **Results of recent NUPEC hydrogen related tests.** Takumi, K. (Nuclear Power Engineering Center, Tokyo (Japan)); Nonaka, A.; Moriya, K.; Ogata, J. Nuclear Regulatory Commission, Washington, DC

(United States). Office of Nuclear Regulatory Research; Brookhaven National Lab., Upton, NY (United States). Apr 1992. (CONF-911079–Vol.2: 19. Nuclear Regulatory Commission (NRC) water reactor safety information meeting, Bethesda, MD (United States), 28-30 Oct 1991). In *Proceedings of the US Nuclear Regulatory Commission nineteenth water reactor safety information meeting. Volume 2, Severe accident research; Severe accident policy implementation; Accident management.* 504p. Source: OSTI; NTIS; INIS; GPO.

Nuclear Power Engineering Center (NUPEC) has started NUPEC containment integrity project entitled 'Proving Test on the Reliability for Reactor Containment Vessel' since June, 1987. This is the project for the term of eleven years sponsored by MITI (Ministry of International Trade and Industry, Japanese Government). Based on the test results, computer codes are verified and as the results of analysis and evaluation by the computer codes, containment integrity is to be confirmed. This paper indicates the results of hydrogen mixing and distribution test and hydrogen burning test. The NUPEC tests conducted so far suggest that hydrogen will be well mixed in the model containment vessel and the prediction by the computer code is in excellent agreement with the data. The NUPEC hydrogen burning test data is in good agreement with the FITS data at Sandia National Laboratories that were obtained at the lower hydrogen concentration condition. New data bases have been added in the higher hydrogen concentration by the NUPEC data.

3349 (NUREG/CP–0119-Vol.2, pp. 139-168) **Comparisons between HDR-H_2-distribution experiments E11.2 and E11.4.** Wolf, L. (Battelle-Europe, Frankfurt am Main (Germany)); Valencia, L.; Wenzel, H.H.; Grimm, R.; Jansen, K. Nuclear Regulatory Commission, Washington, DC (United States). Office of Nuclear Regulatory Research; Brookhaven National Lab., Upton, NY (United States). Apr 1992. (CONF-911079–Vol.2: 19. Nuclear Regulatory Commission (NRC) water reactor safety information meeting, Bethesda, MD (United States), 28-30 Oct 1991). In *Proceedings of the US Nuclear Regulatory Commission nineteenth water reactor safety information meeting. Volume 2, Severe accident research; Severe accident policy implementation; Accident management.* 504p. Source: OSTI; NTIS; INIS; GPO.

The combination of issues important for the physical phenomena governing the H_2-mixing and distribution mechanisms in post-severe accident containment atmospheres, namely: large scale of the experimental facility, high H_2-release rates, superheated steam injection into the containment, multi-compartment geometry with sufficiently large dome volume representation, representative internal concrete and metal structures and surfaces, energy transfer across the containment steel shell into a very high annular ring space of 50 m height, multiple steam and H_2-injection phases, different axial positions for H_2-releases, examination of the efficiency of H_2-mitigating features including external dome, and spray as well as venting, has not been investigated yet in any experimental facility worldwide. The HDR with its subsystems has the features cited above. Therefore, Test Group E11 was designed and performed in 1989 to provide a first data set for severe accident containment atmospheres in close to real multi-compartment geometry. The test group consisted of the total of eight different experiments addressing a wide spectrum of H_2-distribution and mitigation issues. The paper focuses upon two experiments which both cover small break scenarios and a variety of mitigating measures.

3350 (NUREG/CP–0119-Vol.2, pp. 169-188) **Most likely failure location during severe accident conditions.** Rempe, J.L. (Idaho National Engineering Lab., Idaho Falls (United States)); Allison, C.M. Nuclear Regulatory Commission, Washington, DC (United States). Office of Nuclear Regulatory Research; Brookhaven National Lab., Upton, NY (United States). Apr 1992. DOE Contract AC07-76ID01570. (CONF-911079–Vol.2: 19. Nuclear Regulatory Commission (NRC) water reactor safety information meeting, Bethesda, MD (United States), 28-30 Oct 1991). In *Proceedings of the US Nuclear Regulatory Commission nineteenth water reactor safety information meeting. Volume 2, Severe accident research; Severe accident policy implementation; Accident management.* 504p. Source: OSTI; NTIS; INIS; GPO.

This paper describes preliminary results from an analysis in which finite element calculation results are used in conjunction with analytical calculation results to predict failure in different light water reactor (LWR) vessel designs during a severe accident. Detailed analyses are being performed to investigate the relative likelihood of a boiling water reactor (BWR) vessel and drain line penetration to fail during a wide range of severe accident conditions. Analytically developed failure maps, which were developed in terms of dimensionless groups, are applied to consider geometries and materials occurring in other LWR vessel designs. Preliminary numerical analysis results indicate that if ceramic debris relocates within the BWR drain line to a distance below the lower head, the drain line will reach failure temperatures before the vessel fails. Application of failure maps for these debris conditions to other LWR geometries indicate that in-vessel tube melting will occur in either BWR or pressurized water reactor (PWR) vessel designs. Furthermore, if this melt is assumed to fill the entire penetration flow area, the melt is predicted to travel well below the lower head in any of the reference LWR penetrations. However, failure maps suggest the result that ex-vessel tube temperatures exceed the penetration's ultimate strength is specific to the BWR drain line because of its material composition and relatively large effective diameter for melt flow.

3351 (NUREG/CP–0119-Vol.2, pp. 189-197) **On the prediction of steam explosions energetics.** Theofanous, T.G. (Univ. of California, Santa Barbara (United States)); Angelini, S.; Buckles, R.; Yuen, W.W. Nuclear Regulatory Commission, Washington, DC (United States). Office of Nuclear Regulatory Research; Brookhaven National Lab., Upton, NY (United States). Apr 1992. (CONF-911079–Vol.2: 19. Nuclear Regulatory Commission (NRC) water reactor safety information meeting, Bethesda, MD (United States), 28-30 Oct 1991). In *Proceedings of the US Nuclear Regulatory Commission nineteenth water reactor safety information meeting. Volume 2, Severe accident research; Severe accident policy implementation; Accident management.* 504p. Source: OSTI; NTIS; INIS; GPO.

The quantitative aspects of premixing and rate of fragmentation in steam explosions are addressed. For premixing the experiments are focused on the water-depletion phenomenon predicted to occur within the two-dimensional, three-phase, transient mixing zone of a high temperature melt poured into a pool of coolant. These experiments are scaled to yield similar water-depletion regimes as expected in the lower plenum of the reactor vessel. The first, preliminary, results are consistent with numerical predictions. For fragmentation the experiments are focused on observing single exploding melt drops in a steady, elevated pressure field, prototypic of an escalated explosion. The first, preliminary, data demonstrate the interplay between the thermal and hydrodynamic components of the fragmentation-driving mechanism(s), and provide the promise that on such a basis appropriate constitutive laws can be made available for the numerical computation of the escalation and propagation of steam explosions.

3352 (NUREG/CP–0119-Vol.2, pp. 221-234) **Recent development and results from severe accident research in Japan.** Soda, K. (Japan Atomic Energy Research Inst., Ibaraki (Japan)); Sugimoto, J.; Yamano, N.; Shiba, K. Nuclear Regulatory Commission, Washington, DC (United States). Office of Nuclear Regulatory Research; Brookhaven National Lab., Upton, NY (United States). Apr 1992. (CONF-911079–Vol.2: 19. Nuclear Regulatory Commission (NRC) water reactor safety information meeting, Bethesda, MD (United States), 28-30 Oct 1991). In *Proceedings of the US Nuclear Regulatory Commission nineteenth water reactor safety information meeting. Volume 2, Severe accident research; Severe accident policy implementation; Accident management.* 504p. Source: OSTI; NTIS; INIS; GPO.

An overview on Japanese activities of severe accident research is presented, covering various fields and topics of experimental investigation on severe accident phenomena such as fuel damage and melt progression, fission products release and transport, and component and containment integrity. The current status of analytical investigation on severe accident is also described in the fields of the level-1 and level-2 probabilistic safety assessment (PSA) studies, code development and assessment activities. The basic considerations on accident management are summarized.

3353 (NUREG/CP–0119-Vol.2, pp. 211-219) **Main safety issues related to IPSN severe accident research.** LeComte, C. (CEA French Atomic Energy Commission, Fontenay-aux-Roses (France)). Nuclear Regulatory Commission, Washington, DC (United States). Office of Nuclear Regulatory Research; Brookhaven National Lab., Upton, NY (United States). Apr 1992. (CONF-911079–Vol.2: 19. Nuclear Regulatory Commission (NRC) water reactor safety information meeting, Bethesda, MD (United States), 28-30 Oct 1991). In *Proceedings of the US Nuclear Regulatory Commission nineteenth water reactor safety information meeting. Volume 2, Severe accident research; Severe accident policy implementation; Accident management.* 504p. Source: OSTI; NTIS; INIS; GPO.

Institute for Nuclear Protection and Safety (IPSN) has developed a rationale for accident studies which involves both analytical and crisis strategies. The operational aim to provide as high as possible prevention of damage for installations and environment is fulfilled during accidental and post-accidental phases through development of crisis tools and analysis of emergency plans. Further research will provide still more detailed insight into release prevention capabilities and environment recovery techniques.

3354 (NUREG/CP–0119-Vol.2, pp. 241-263) **Parameter effects on molten debris spreading and coolability.** Moody, F.J. (GE Nuclear Energy, San Jose, CA (United States)); Fruth, K.M.; Muralidharan, R. Nuclear Regulatory Commission, Washington, DC (United States). Office of Nuclear Regulatory Research; Brookhaven National Lab., Upton, NY (United States). Apr 1992. (CONF-911079–Vol.2: 19. Nuclear Regulatory Commission (NRC) water reactor safety information meeting, Bethesda, MD (United States), 28-30 Oct 1991). In *Proceedings of the US Nuclear Regulatory Commission nineteenth water reactor safety information meeting. Volume 2, Severe accident research; Severe accident policy implementation; Accident management.* 504p. Source: OSTI; NTIS; INIS; GPO.

The spreading, cooling, and freezing of molten core debris on a horizontal surface during a postulated severe accident are important considerations which influence the containment thermal response. This study describes theoretical models for predicting the time-dependent spreading geometry of molten core debris on a horizontal floor, and several associated cooling responses. It was found that corium discharge from a doorway tends to have a spreading angle of about 52 degrees when surface tension is negligible. Simplified heat transfer models are employed to estimate local freezing and mounding of flowing corium, which can diminish its coolability. Effects of metal/oxide stratification and voids on the hot spot temperature also are included. It is shown that when corium arrives at a wall, the resulting hot spot temperature is reduced if the wall slopes away from the corium.

3355 (NUREG/CP–0119-Vol.2, pp. 265-290) **Analyses of corium spreading in Mark I containment geometry.** Sienicki, J.J. (Argonne National Lab., IL (United States)); Chu, C.C.; Farmer, M.T. Nuclear Regulatory Commission, Washington, DC (United States). Office of Nuclear Regulatory Research; Brookhaven National Lab., Upton, NY (United States). Apr 1992. (CONF-911079–Vol.2: 19. Nuclear Regulatory Commission (NRC) water reactor safety information meeting, Bethesda, MD (United States), 28-30 Oct 1991). In *Proceedings of the US Nuclear Regulatory Commission nineteenth water reactor safety information meeting. Volume 2, Severe accident research; Severe accident policy implementation; Accident management.* 504p. Source: OSTI; NTIS; INIS; GPO.

An assessment of melt spreading in the Mark I system has been carried out using the MELTSPREAD-1 computer code together with supporting analyses. Application of MELTSPREAD-1 confirms the calculation of shell survival in a wet containment for the most probable melt release conditions from NUREG/CR-5423. According to MELTSPREAD-1, a dry containment also may not be threatened by melt spreading. This reflects the heat losses undergone by the melt in the process of spreading to the shell conservatively neglected in NUREG/CR-5423. However, there exist parameter ranges outside the most probable set where shell failure may be calculated. Accounting for the breakup and quenching of melt relocating through a deep layer of subcooled water also conservatively neglected in NUREG/CR-5423 can reduce the set of parameter variations for which containment failure is calculated in the wet case.

3356 (NUREG/CP–0119-Vol.2, pp. 291-300) **ACE project Phases C and D: ACE/MCCI and MACE tests.** Sehgal, B.R. (Electric Power Research Inst., Palo Alto, CA (United States)); Spencer, B.W.; Thompson, D.H.; Fink, J.K.; Farmer, M.T. Nuclear Regulatory Commission, Washington, DC (United States). Office of Nuclear Regulatory Research; Brookhaven National Lab., Upton, NY (United States). Apr 1992. (CONF-911079–Vol.2: 19. Nuclear Regulatory Commission (NRC) water reactor safety information meeting, Bethesda, MD (United States), 28-30 Oct 1991). In *Proceedings of the US Nuclear Regulatory Commission nineteenth water reactor safety information meeting. Volume 2, Severe accident research; Severe accident policy implementation; Accident management.* 504p. Source: OSTI; NTIS; INIS; GPO.

Programs of experiments and related analysis are underway at Argonne National Laboratory investigating the interaction of molten core material with concrete and its coolability. The major objectives are: (1) obtain data on fission product release during molten corium concrete interactions (MCCI); and (2) investigate the conditions for successful cooling and stabilization of core melt attacking the concrete basemat. The fission product release tests have been completed, and data analysis is in progress. The experiments will be analyzed by several groups to validate the various MCCI codes, e.g., CORCON and VANESA, WECHSL and MAAP-DECOMP. A scoping melt attach and coolability experiment (MACE) involving the addition of water atop an on-going MCCI has been performed. A facility to conduct larger scale tests is currently being constructed, and two addition tests are planned to be completed before the end of CY91. This paper describes the progress of the MCCI and the MACE testing programs in the ACE project.

3357 (NUREG/CP–0119-Vol.2, pp. 235-239) **Core-concrete interactions with overlying water pools.** Copus, E.R. (Sandia National Labs., Albuquerque, NM (United States)). Nuclear Regulatory Commission, Washington, DC (United States). Office of Nuclear Regulatory Research; Brookhaven National Lab., Upton, NY (United States). Apr 1992. (CONF-911079–Vol.2: 19. Nuclear Regulatory Commission (NRC) water reactor safety information meeting, Bethesda, MD (United States), 28-30 Oct 1991). In *Proceedings of the US Nuclear Regulatory Commission nineteenth water reactor safety information meeting. Volume 2, Severe accident research; Severe accident policy implementation; Accident management.* 504p. Source: OSTI; NTIS; INIS; GPO.

An inductively heated experiment, WETCOR-1, was executed as part of the Nuclear Regulatory Commission (NRC) research program to study and evaluate core debris coolability by overlying water pools. A 35 kg charge material of 80 wt. percent Al_2O_3-20 wt. percent CaO was heated to melting at 1,850K within a 32 cm diameter tungsten annulus heated to 2,100K. Ablation of a limestone-common and concrete basemat was allowed to begin and water at 293K was then added continuously at 60 liters per minute. Both power and water flow were terminated after a 30 minute test period. The main observations from the WETCOR-1 test were that there was an initial period of vigorous melt-water interaction which lasted for 1-2 minutes and was replaced by a relatively stable crust-water geometry with substantially reduced rates of energy transfer to the overlying water. These rates of energy transfer were insufficient to either quench the melt or to discontinue the pre-established meltpool-concrete ablation process.

3358 (NUREG/CP–0119-Vol.2, pp. 301-324) **The Integral Effects Test (IET-1) in the Surtsey Test Facility.** Allen, M.D. (Sandia National Labs., Albuquerque, NM (United States)); Griffith, R.O.; Pilch, M.M.; Nichols, R.T. Nuclear Regulatory Commission, Washington, DC (United States). Office of Nuclear Regulatory Research; Brookhaven National Lab., Upton, NY (United States). Apr 1992. (CONF-911079–Vol.2: 19. Nuclear Regulatory Commission (NRC) water reactor safety information meeting, Bethesda, MD (United States), 28-30 Oct 1991). In *Proceedings of the US Nuclear Regulatory Commission nineteenth water reactor safety information meeting. Volume 2, Severe accident research; Severe accident policy implementation; Accident management.* 504p. Source: OSTI; NTIS; INIS; GPO.

The first experiment of the Integral Effects Test (IET-1) series was conducted to investigate the effects of high pressure melt ejection (HPME) on direct containment heating (DCH). A 1:10 linear scale model of the Zion reactor pressure vessel (RPV), cavity, instrument tunnel, and subcompartment structures were constructed in the Surtsey Test Facility at Sandia National Laboratories (SNL). The RPV was modeled with a melt generator that consisted of a steel pressure barrier, a cast MgO crucible, and a thin steel inner liner. The melt generator/crucible had a semi-hemispherical bottom head containing a graphite limitor plate with a 3.5 cm exit hole to simulate the ablated hole in the RPV bottom head that would be formed by tube ejection in a severe nuclear power plant (NPP) accident. The reactor cavity model contained 3.48 kg of water with a depth of 0.9 cm that corresponded to condensate levels in the Zion plant. A steam driven iron oxide/aluminum/chromium thermite was used to simulate HPME. A relatively small steam explosion occurred in the cavity during IET-1. Steam blowthrough entrained debris into the Surtsey vessel resulting in a peak pressure increase in Surtsey of 98 kPa. The Surtsey vessel had been previously inerted with N_2. The total debris mass ejected into the Surtsey vessel was 43 kg. The hydrogen concentration was 3.1 mol.% in the vessel at equilibrium. The concentration measured inside the subcompartment structures immediately following HPME transient was 20.7 mol.% H_2.

3359 (NUREG/CP–0119-Vol.2, pp. 325-342) **Iodine chemical forms in LWR severe accidents.** Beahm, E.C. (Oak Ridge National Lab., TN (United States)); Weber, C.F.; Kress, T.S.; Parker, G.W. Nuclear Regulatory Commission, Washington, DC (United States). Office of Nuclear Regulatory Research; Brookhaven National Lab., Upton, NY (United States). Apr 1992. DOE Contract AC05-84OR21400. (CONF-911079–Vol.2: 19. Nuclear Regulatory Commission (NRC) water reactor safety information meeting, Bethesda, MD (United States), 28-30 Oct 1991). In *Proceedings of the US Nuclear Regulatory Commission nineteenth water reactor safety information meeting. Volume 2, Severe accident research; Severe accident policy implementation; Accident management.* 504p. Source: OSTI; NTIS; INIS; GPO.

Calculated data from seven severe accident sequences in light-water reactor plants were used to assess the chemical forms of iodine in containment. In most of the calculations for the seven sequences, iodine entering containment from the reactor coolant system was almost entirely in the form of CsI with very small contributions of I or HI. The largest fraction of iodine in forms other than CsI was a total of 3.2% as I plus HI. Within the containment, the CsI will deposit onto walls and other surfaces, as well as in water pools, largely in the form of iodide (I^-). The radiation induced conversion of I^- in water pools into I_2 is strongly dependent on pH. In systems where the pH was controlled above 7, little additional elemental iodine would be produced in the containment atmosphere. When the pH falls below 7, it may be assumed that it is not being controlled, and large fractions of iodine as I_2 within the containment atmosphere may be produced.

3360 (NUREG/CP–0119-Vol.2, pp. 343-365) **Calculation of fuel pin failure timing under LOCA conditions.** Jones, K.R. (Idaho National Engineering Lab., Idaho Falls (United States)); Wade, N.L.; Siefken, L.J.; Straka, M.; Katsma, K.R. Nuclear Regulatory Commission, Washington, DC (United States). Office of Nuclear Regulatory Research; Brookhaven National Lab., Upton, NY (United States). Apr 1992. DOE Contract AC07-76ID01570. (CONF-911079–Vol.2: 19. Nuclear Regulatory Commission (NRC) water reactor safety information meeting, Bethesda, MD (United States), 28-30 Oct 1991). In *Proceedings of the US Nuclear Regulatory Commission nineteenth water reactor safety information meeting. Volume 2, Severe accident research; Severe accident policy implementation; Accident management.* 504p. Source: OSTI; NTIS; INIS; GPO.

The objective of this research was to develop and demonstrate a methodology for calculation of the time interval between receipt of the containment isolation signals and the first fuel pin failure for loss-of-coolant accidents (LOCAs). Demonstration calculations were performed for a Babcock and Wilcox design (Oconee) and a Westinghouse 4-loop design (Seabrook). Sensitivity studies were performed to assess the impacts of fuel pin burnup, axial peaking factor, break size, emergency core cooling system availability, and main coolant pump trip on these times. The analysis was performed using a four-code approach, comprised of FRAPCON-2, SCDAP/RELAP5/MOD3, TRAC-PF1/MOD1, and FRAP-T6. In addition to the calculation of timing results, this analysis provided a comparison of the capabilities of SCDAP/RELAP5/MOD3 with TRAC-PF1/MOD1 for large-break LOCA analysis. This paper discusses the methodology employed and the code development efforts required to implement the methodology. The shortest time intervals calculated between initiation of containment isolation and fuel pin failure were 11.4 s and 19.1 s for the Babcock and Wilcox and Westinghouse plants, respectively. The FRAP-T6 fuel pin failure times calculated using thermal-hydraulic data generated by SCDAP/RELAP5/MOD3 were more conservative than those calculated using data generated by TRAC-PF1/MOD1.

3361 (NUREG/CP–0119-Vol.2, pp. 383-401) **Managing water addition to a degraded core.** Kuan, P. (Idaho National Engineering Lab., Idaho Falls (United States)); Hanson, D.J.; Odar, F. Nuclear Regulatory Commission, Washington, DC (United States). Office of Nuclear Regulatory Research; Brookhaven National Lab., Upton, NY (United States). Apr 1992. (CONF-911079–Vol.2: 19. Nuclear Regulatory Commission (NRC) water reactor safety information meeting, Bethesda, MD (United States), 28-30 Oct 1991). In *Proceedings of the US Nuclear Regulatory Commission nineteenth water reactor safety information meeting. Volume 2, Severe accident research; Severe accident policy implementation; Accident management.* 504p. Source: OSTI; NTIS; INIS; GPO.

In this paper the authors present information that can be used in severe accident management by providing an improved understanding of the effects of water addition to a degraded core. This improved understanding is developed using a diagram showing a sequence of core damage states. Whenever possible, a temperature and a time after accident initiation are estimated for each damage state in the sequence diagram. This diagram can be used to anticipate the evolution of events during an accident. Possible responses of plant instruments are described to identify these damage states and the effects of water addition. The rate and amount of water addition needed (a) to remove energy from the core, (b) to stabilize the core or (c) to not adversely affect the damage progression, are estimated. Analysis of the capability to remove energy from large cohesive and particulate debris beds indicates that these beds may not be stabilized in the core region and they may partially relocate to the lower plenum of the reactor vessel.

3362 (NUREG/CP–0119-Vol.2, pp. 403-413) **US nuclear industry approach to severe accident management guidance development and implementation.** Modeen, D. (Nuclear Management and Resources Council, Washington, DC (United States)); Walsh, L.; Oehlberg, R. Nuclear Regulatory Commission, Washington, DC (United States). Office of Nuclear Regulatory Research; Brookhaven National Lab., Upton, NY (United States). Apr 1992. (CONF-911079–Vol.2: 19. Nuclear Regulatory Commission (NRC) water reactor safety information meeting, Bethesda, MD (United States), 28-30 Oct 1991). In *Proceedings of the US Nuclear Regulatory Commission nineteenth water reactor safety information meeting. Volume 2, Severe accident research; Severe accident policy implementation; Accident management.* 504p. Source: OSTI; NTIS; INIS; GPO.

The purpose of this paper is to discuss the US nuclear industry activities, occurring under the auspices of Nuclear Management and Resources Council (NUMARC), to define, develop and implement enhancements to utility accident management capabilities. This effort consists of three major parts: (1) Development of a practical framework for evaluation of plant-specific accident management capabilities and the subsequent implementation of selected enhancements. (2) Development of specific technical guidance that address arresting core damage if it begins, either in-vessel or ex-vessel, and maintaining containment integrity. Preventing inadequate core cooling or minimizing the consequences of offsite releases, while considered to be candidate areas for accident management enhancements, have been the subject of intense previous study and development. (3) Plant-specific implementation of accident management enhancements in three areas: (a) personnel resources (organization, training, communications); (b) systems

and equipment (restoration and repair, instrumentation, use of alternatives); and (c) information resources (procedures and guidance, technical information, process information).

3363 (NUREG/CP–0119-Vol.2, pp. 415-436) **A structured approach to individual plant evaluation and accident management.** Klopp, G.T. (Commonwealth Edison Co., Downers Grove, IL (United States)). Nuclear Regulatory Commission, Washington, DC (United States). Office of Nuclear Regulatory Research; Brookhaven National Lab., Upton, NY (United States). Apr 1992. (CONF-911079–Vol.2: 19. Nuclear Regulatory Commission (NRC) water reactor safety information meeting, Bethesda, MD (United States), 28-30 Oct 1991). In *Proceedings of the US Nuclear Regulatory Commission nineteenth water reactor safety information meeting. Volume 2, Severe accident research; Severe accident policy implementation; Accident management.* 504p. Source: OSTI; NTIS; INIS; GPO.

The need for long term development of accident management programs is acknowledged and the key tool for that development is identified as the IPE Program. The Edison commitment to build an integrated program is cited and the effect on the IPE effort is considered. Edison's integrated program is discussed in detail. The key benefits, realism and long term savings, are discussed. Some of the highly visible products such as neural network artificial intelligence systems are cited.

3364 (NUREG/CP–0119-Vol.2, pp. 437-460) **A framework for the assessment of severe accident management strategies.** Kastenberg, W.E. (Univ. of California, Los Angeles (United States)); Apostolakis, G.; Dhir, V.K.; Okrent, D.; Jae, M.; Lim, H.; Milici, T.; Park, H.; Swider, J.; Xing, L.; Yu, D. Nuclear Regulatory Commission, Washington, DC (United States). Office of Nuclear Regulatory Research; Brookhaven National Lab., Upton, NY (United States). Apr 1992. (CONF-911079–Vol.2: 19. Nuclear Regulatory Commission (NRC) water reactor safety information meeting, Bethesda, MD (United States), 28-30 Oct 1991). In *Proceedings of the US Nuclear Regulatory Commission nineteenth water reactor safety information meeting. Volume 2, Severe accident research; Severe accident policy implementation; Accident management.* 504p. Source: OSTI; NTIS; INIS; GPO.

Accident management can be defined as the innovative use of existing and or alternative resources, systems and actions to prevent or mitigate a severe accident. Together with risk management (changes in plant operation and/or addition of equipment) and emergency planning (off-site actions), accident management provides an extension of the defense-in-depth safety philosophy for severe accidents. A significant number of probabilistic safety assessments (PSA) have been completed which yield the principal plant vulnerabilities. For each sequence/threat and each combination of strategy there may be several options available to the operator. Each strategy/option involves phenomenological and operational considerations regarding uncertainty. These considerations include uncertainty in key phenomena, uncertainty in operator behavior, uncertainty in system availability and behavior, and uncertainty in available information (i.e., instrumentation). The objective of this project is to develop a methodology for assessing severe accident management strategies given the key uncertainties mentioned above. Based on decision trees and influence diagrams, the methodology is currently being applied to two case studies: cavity flooding in a pressurized water reactor to prevent vessel penetration or failure, and drywell flooding in a boiling water reactor to prevent containment failure.

3365 (NUREG/CP–0119-Vol.2, pp. 461-484) **Assessment of two BWR accident management strategies.** Hodge, S.A. (Oak Ridge National Lab., TN (United States)); Petek, M. Nuclear Regulatory Commission, Washington, DC (United States). Office of Nuclear Regulatory Research; Brookhaven National Lab., Upton, NY (United States). Apr 1992. DOE Contract AC05-84OR21400. (CONF-911079–Vol.2: 19. Nuclear Regulatory Commission (NRC) water reactor safety information meeting, Bethesda, MD (United States), 28-30 Oct 1991). In *Proceedings of the US Nuclear Regulatory Commission nineteenth water reactor safety information meeting. Volume 2, Severe accident research; Severe accident policy implementation; Accident management.* 504p. Source: OSTI; NTIS; INIS; GPO.

Candidate mitigative strategies for management of in-vessel events during the late phase (after core degradation has occurred) of postulated boiling water reactor (BWR) severe accidents were considered at Oak Ridge National Laboratory (ORNL) during 1990. The identification of new strategies was subject to the constraint that they should, to the maximum extent possible, make use of the existing equipment and water resources of the BWR facilities and not require major equipment modifications or additions. As a result of this effort, two of these candidate strategies were recommended for additional assessment. The first is a strategy for containment flooding to maintain the core and structural debris within the reactor vessel in the event that vessel injection cannot be restored to terminate a severe accident sequence. The second strategy pertains to the opposite case, for which vessel injection would be restored after control blade melting had begun; its purpose is to provide an injection source of borated water at the concentration necessary to preclude criticality upon recovering a damaged BWR core. Assessments of these two strategies have been performed during 1991 under the auspices of the Detailed Assessment of BWR In-Vessel Strategies Program. This paper provides a discussion of the motivation for and purpose of these strategies and the potential for their success.

3366 (NUREG/CP–0119-Vol.3, pp. 1-11) **Studies performed in support of the proposed revision of engineering design aspects of 10CFR100, Appendix A.** Witte, M. (Lawrence Livermore National Lab., CA (United States)); Prassinos, P. Nuclear Regulatory Commission, Washington, DC (United States). Office of Nuclear Regulatory Research; Brookhaven National Lab., Upton, NY (United States). Apr 1992. (CONF-911079–Vol.3: 19. Nuclear Regulatory Commission (NRC) water reactor safety information meeting, Bethesda, MD (United States), 28-30 Oct 1991). In *Proceedings of the US Nuclear Regulatory Commission nineteenth water reactor safety information meeting. Volume 3, Structural engineering; Advanced reactor research; Advanced passive reactors; Human factors research; Human factors issues related to advanced passive LWRs; Thermal hydraulics; Earth sciences.* 542p. Source: OSTI; NTIS; INIS; GPO.

Part 100 of Title 10 of the Code of Federal Regulations (10CFR100) describes criteria which guide the commission in its evaluation of the suitability of proposed sites for nuclear power plants. Appendix A of this part describes seismic and geologic siting criteria for nuclear power plants. Some engineering design aspects of nuclear power plants are also briefly addressed in Appendix A. These include: definition of the operating basis earthquake (OBE) and the safe shutdown earthquake (SSE), definitions of safety related structures, systems and components, ratio of OBE to SSE, identification of acceptable analytical methods, and definition of vibratory ground motion. One of the interpretations of the regulations on the selection of the two earthquake design levels, the SSE and OBE, was that the SSE would control the design of all safety related systems while the OBE would be applied to the remaining systems required for continued power operation. In practice, however, with the load factors, damping, and service limits, the OBE, rather than the SSE, has controlled the design for some systems. The work in progress at Lawrence Livermore National Laboratory and at the Nuclear Regulatory Commission will develop the technical basis to support engineering related changes to Appendix A. Included in this effort are the following: investigation of the impact of removing the OBE from design considerations with regard to safety options and review of possible strategies regarding the definition and requirements of the OBE for future reactors. This paper reports on the status and results of studies performed to date in support of this project.

3367 (NUREG/CP–0119-Vol.3, pp. 13-23) **Enhancing the seismic margin review methodology to obtain risk insights.** Budnitz, R.J. (Future Resources Associates, Inc., Berkeley, CA (United States)). Nuclear Regulatory Commission, Washington, DC (United States). Office of Nuclear Regulatory Research; Brookhaven National Lab., Upton, NY (United States). Apr 1992. (CONF-911079–Vol.3: 19. Nuclear Regulatory Commission (NRC) water reactor safety information meeting, Bethesda, MD (United States), 28-30 Oct 1991). In *Proceedings of the US Nuclear Regulatory Commission nineteenth water reactor safety information*

meeting. Volume 3, Structural engineering; Advanced reactor research; Advanced passive reactors; Human factors research; Human factors issues related to advanced passive LWRs; Thermal hydraulics; Earth sciences. 542p. Source: OSTI; NTIS; INIS; GPO.

This paper discusses methods for obtaining risk insights from the seismic margin review (SMR) methodology. The SMR methodology was originally developed in 1984-1987 with the objective of analyzing an individual nuclear power plant to ascertain whether the plant has the ability to withstand earthquakes substantially beyond the design-basis earthquake without suffering a core-damage accident. Recently, in the context of Nuclear Regulatory Commission's (NRC's) Individual Plant Evaluation for External Events (IPEEE) program, the SMR methodology has been developed further by NRC to allow plants to identify plant-specific vulnerabilities (in the IPEEE sense) to seismic events. The objective of these enhancements has been to provide a methodology for IPEEE seismic review that is substantially less expensive than a full-scope seismic PRA, but that achieves the IPEEE's vulnerability-search objectives. In this paper, the steps involved in the enhanced methodology are discussed.

3368 (NUREG/CP–0119-Vol.3, pp. 25-39) **Large-Scale Seismic Test Program at Hualien, Taiwan.** Tang, H.T. (Electric Power Research Inst., Palo Alto, CA (United States)); Graves, H.L.; Chen, P.C. Nuclear Regulatory Commission, Washington, DC (United States). Office of Nuclear Regulatory Research; Brookhaven National Lab., Upton, NY (United States). Apr 1992. (CONF-911079–Vol.3: 19. Nuclear Regulatory Commission (NRC) water reactor safety information meeting, Bethesda, MD (United States), 28-30 Oct 1991). In *Proceedings of the US Nuclear Regulatory Commission nineteenth water reactor safety information meeting. Volume 3, Structural engineering; Advanced reactor research; Advanced passive reactors; Human factors research; Human factors issues related to advanced passive LWRs; Thermal hydraulics; Earth sciences.* 542p. Source: OSTI; NTIS; INIS; GPO.

The Large-Scale Seismic Test (LSST) Program at Hualien, Taiwan, is a follow-on to the soil-structure interaction (SSI) experiments at Lotung, Taiwan. The planned SSI studies will be performed at a stiff soil site in Hualien, Taiwan, that historically has had slightly more destructive earthquakes in the past than Lotung. The LSST is a joint effort among many interested parties. Electric Power Research Institute (EPRI) and Taipower are the organizers of the program and have the lead in planning and managing the program. Other organizations participating in the LSST program are US Nuclear Regulatory Commission, the Central Research Institute of Electric Power Industry, the Tokyo Electric Power Company, the Commissariat A L'Energie Atomique, Electricite de France and Framatome. The LSST was initiated in January 1990, and is envisioned to be five years in duration. Based on the assumption of stiff soil and confirmed by soil boring and geophysical results the test model was designed to provide data needed for SSI studies covering: free-field input, nonlinear soil response, non-rigid body SSI, torsional response, kinematic interaction, spatial incoherency and other effects. Taipower had the lead in design of the test model and received significant input from other LSST members. Questions raised by LSST members were on embedment effects, model stiffness, base shear, and openings for equipment. This paper describes progress in site preparation, design and construction of the model and development of an instrumentation plan.

3369 (NUREG/CP–0119-Vol.3, pp. 41-57) **Containment performance experiments under severe accident loadings.** Parks, M.B. (Sandia National Labs., Albuquerque, NM (United States)); Spletzer, B.L.; Lambert, L.D.; Weatherby, J.R. Nuclear Regulatory Commission, Washington, DC (United States). Office of Nuclear Regulatory Research; Brookhaven National Lab., Upton, NY (United States). Apr 1992. DOE Contract AC04-76DP00789. (CONF-911079–Vol.3: 19. Nuclear Regulatory Commission (NRC) water reactor safety information meeting, Bethesda, MD (United States), 28-30 Oct 1991). In *Proceedings of the US Nuclear Regulatory Commission nineteenth water reactor safety information meeting. Volume 3, Structural engineering; Advanced reactor research; Advanced passive reactors; Human factors research; Human factors issues related to advanced passive LWRs; Thermal hydraulics; Earth sciences.* 542p. Source: OSTI; NTIS; INIS; GPO.

This paper provides a summary and status report for two ongoing experimental programs. The purpose of each program is to determine the behavior of certain components of the containment pressure boundary when subjected to severe accident conditions. The first program is investigating the effect of various parameters on tearing of the steel liner in reinforced concrete containments. The second will attempt to determine if worst-case containment loading conditions are capable of causing leakage through piping penetration bellows. The liner test program is almost complete; however, the bellows tests have not yet begun. Therefore, the emphasis of the paper is on the liner experiments. The research activities described herein are a part of the Containment Integrity Programs, which are managed by Sandia National Laboratories for the US Nuclear Regulatory Commission.

3370 (NUREG/CP–0119-Vol.3, pp. 59-90) **High level seismic/vibrational tests at the HDR - An overview.** Kot, C.A. (Argonne National Lab., IL (United States)); Srinivasan, M.G.; Hsieh, B.J.; Schrammel, D.; Malcher, L.; Steinhilber, H.; Costello, J.F. Nuclear Regulatory Commission, Washington, DC (United States). Office of Nuclear Regulatory Research; Brookhaven National Lab., Upton, NY (United States). Apr 1992. (CONF-911079–Vol.3: 19. Nuclear Regulatory Commission (NRC) water reactor safety information meeting, Bethesda, MD (United States), 28-30 Oct 1991). In *Proceedings of the US Nuclear Regulatory Commission nineteenth water reactor safety information meeting. Volume 3, Structural engineering; Advanced reactor research; Advanced passive reactors; Human factors research; Human factors issues related to advanced passive LWRs; Thermal hydraulics; Earth sciences.* 542p. Source: OSTI; NTIS; INIS; GPO.

As part of the Phase 2 testing at the HDR Test Facility in Kahl/Main, Federal Republic of Germany two series of high-level seismic/vibrational experiments were performed. In the first of these (SHAG) a coast-down shaker, mounted on the reactor operating floor and capable of generating 1,000 tonnes of force, was used to investigate full-scale structural response, soil-structure interaction (SSI), and piping/equipment response at load levels equivalent to those of a design basis earthquake. The HDR soil/structure system was tested to incipient failure exhibiting highly nonlinear response. In the load transmission from structure to piping/equipment significant response amplifications and shifts to higher frequencies occurred. The performance of various pipe support configurations was evaluated. This latter effort was continued in the second series of tests (SHAM), in which an in-plant piping system was investigated at simulated seismic loads (generated by two servo-hydraulic actuators each capable of generating 40 tonnes of force), that exceeded design levels manifold and resulted in considerable pipe plastification and failure of some supports (snubbers). The evaluation of six different support configurations demonstrated that proper system design (for a given spectrum) rather than number of supports or system stiffness is essential to limiting pipe stresses. Pipe strains at loads exceeding the design level eightfold were still tolerable, indicating that pipe failure even under extreme seismic loads is unlikely in spite of multiple support failures. Conservatively, an excess capacity (margin) of at least four was estimated for the piping system, and the pipe damping was found to be 4%.

3371 (NUREG/CP–0119-Vol.3, pp. 91-114) **Progress in research on aging of structures.** Naus, D.J. (Oak Ridge National Lab., TN (United States)); Oland, C.B.; Ellingwood, B.; Mori, Y.; Arndt, E.G. Nuclear Regulatory Commission, Washington, DC (United States). Office of Nuclear Regulatory Research; Brookhaven National Lab., Upton, NY (United States). Apr 1992. DOE Contract AC05-84OR21400. (CONF-911079–Vol.3: 19. Nuclear Regulatory Commission (NRC) water reactor safety information meeting, Bethesda, MD (United States), 28-30 Oct 1991). In *Proceedings of the US Nuclear Regulatory Commission nineteenth water reactor safety information meeting. Volume 3, Structural engineering; Advanced reactor research; Advanced passive reactors; Human factors research; Human factors issues related to advanced passive LWRs; Thermal hydraulics; Earth sciences.* 542p. Source: OSTI; NTIS; INIS; GPO.

The Structural Aging (SAG) Program is conducted for the Nuclear Regulatory Commission. The program has the overall objective of preparing an expandable handbook or report which will

provide the NRC with potential structural safety issues and acceptance criteria for use in nuclear power plant evaluations for continued service. Initial focus of the program is on concrete and concrete-related materials which comprise the safety-related (Category 1) structures in light-water reactor facilities. The program consists of a management task and three technical tasks: materials property data base, structural component assessment/repair technology, and quantitative methodology for continued service determinations. Objectives, background information, and accomplishments under each of these tasks are presented.

3372 (NUREG/CP–0119-Vol.3, pp. 115-139) **Tests in the ATLE loop on the PIUS design.** Bredolt, U. (ABB Atom AB, Vaesteraas (Sweden)); Babala, D.; Kemppainen, J. Nuclear Regulatory Commission, Washington, DC (United States). Office of Nuclear Regulatory Research; Brookhaven National Lab., Upton, NY (United States). Apr 1992. (CONF-911079–Vol.3: 19. Nuclear Regulatory Commission (NRC) water reactor safety information meeting, Bethesda, MD (United States), 28-30 Oct 1991). In *Proceedings of the US Nuclear Regulatory Commission nineteenth water reactor safety information meeting. Volume 3, Structural engineering; Advanced reactor research; Advanced passive reactors; Human factors research; Human factors issues related to advanced passive LWRs; Thermal hydraulics; Earth sciences.* 542p. Source: OSTI; NTIS; INIS; GPO.

This paper describes experimental demonstration of the self-protective features of Process Inherent Ultimate Safety (PIUS) design in a large scale test loop in ABB Atoms engineering laboratories. The loop employs real time simulation of core power as a function of coolant conditions in an electrically heated fuel assembly model. System responses to various severe transients were studied. Comparisons were made with predictions of the RIGEL code, which has been developed specifically for study of PIUS type reactors. A comparison between test results and calculated results was made for main state variables such as pressure, temperatures, concentrations, heat fluxes and mass flow rates. The tests have demonstrated the self-protective thermal-hydraulics of pressurized water reactor primary systems designed according to the PIUS principle and verified the capability of the RIGEL code to predict their behavior during severe accidents and in normal operation transients.

3373 (NUREG/CP–0119-Vol.3, pp. 141-160) **Exploiting digital systems technology to improve nuclear safety.** Olmstead, R.A. (Atomic Energy of Canada Limited, Chalk River, Ontario (Canada)); Ichiyen, N.M.; Pauksens, J. Nuclear Regulatory Commission, Washington, DC (United States). Office of Nuclear Regulatory Research; Brookhaven National Lab., Upton, NY (United States). Apr 1992. (CONF-911079–Vol.3: 19. Nuclear Regulatory Commission (NRC) water reactor safety information meeting, Bethesda, MD (United States), 28-30 Oct 1991). In *Proceedings of the US Nuclear Regulatory Commission nineteenth water reactor safety information meeting. Volume 3, Structural engineering; Advanced reactor research; Advanced passive reactors; Human factors research; Human factors issues related to advanced passive LWRs; Thermal hydraulics; Earth sciences.* 542p. Source: OSTI; NTIS; INIS; GPO.

Nuclear plant designers in the 1990's have exceptional opportunities to exploit rapidly evolving computer and information system technology to make significant improvements in public safety. CANDU reactors have utilized extensive computer automation for reactor control for 20 years. A direct consequence is that the frequencies for forced outages and spurious protection system trips have been among the lowest for all reactor types. Historically, CANDU was among the first commercial power reactor to utilize computers to implement protection system. System functions with the PDC's (Programmable Digital Comparators) used in the CANDU 600 reactors. PDC's were used to implement the trip decision logic for the process trip parameters. The paper provides detail on safety benefits that have been realized from the use of digital automation for control and protection. The paper describes how accident risk reduction can be achieved in other ways with digital systems.

3374 (NUREG/CP–0119-Vol.3, pp. 161-181) **Analysis of postulated events for the revised ALMR/PRISM design.** Slovik, G.C. (Brookhaven National Lab., Upton, NY (United States)); Tuyle, G.J. Van. Nuclear Regulatory Commission, Washington, DC (United States). Office of Nuclear Regulatory Research; Brookhaven National Lab., Upton, NY (United States). Apr 1992. (CONF-911079–Vol.3: 19. Nuclear Regulatory Commission (NRC) water reactor safety information meeting, Bethesda, MD (United States), 28-30 Oct 1991). In *Proceedings of the US Nuclear Regulatory Commission nineteenth water reactor safety information meeting. Volume 3, Structural engineering; Advanced reactor research; Advanced passive reactors; Human factors research; Human factors issues related to advanced passive LWRs; Thermal hydraulics; Earth sciences.* 542p. Source: OSTI; NTIS; INIS; GPO.

The Nuclear Regulatory Commission (NRC) is continuing a pre-application review of the 471 MWt, liquid metal reactor, PRISM, by General Electric, with Brookhaven National Laboratory providing technical support. The revised design has been evaluated, using the SSC code, for an unscrammed loss of heat sink (ULOHS), an unscrammed loss of flow (ULOF) with and without the Gas Expansion Modules (GEMs), and a 40¢ unscrammed transient overpower (UTOP) event. The feedback effects for U-27Pu-10Zr metal fuel were modeled in SSC. The ULOHS accident was determined to be a benign event for the design, with the reactor power transitioning down to a decay heat level within 500s. The power during the postulated ULOF events, with the GEMs functioning, transitioned to decay heat levels without fuel damage, and included a 300K margin to sodium saturation. The case without the GEMs had only a 160K margin to sodium saturation and higher fuel temperatures. In addition, the clad was predicted to quickly pass through the eutectic phase (between fuel and clad), and some clad wastage would result. The 40¢ UTOP was predicted to raise the power to 1.8 rated, which later stabilized near 1.2 times full power. SSC predicted some localized fuel melting for the event, but the significance of this localized damage has not yet been determined. If necessary, the vendor has options to reduce the maximum reactivity insertion below 40¢.

3375 (NUREG/CP–0119-Vol.3, pp. 183-196) **Accident simulation and consequence analysis in support of MHTGR safety evaluations.** Ball, S.J. (Oak Ridge National Lab., TN (United States)); Wichner, R.P.; Smith, O.L.; Conklin, J.C.; Barthold, W.P. Nuclear Regulatory Commission, Washington, DC (United States). Office of Nuclear Regulatory Research; Brookhaven National Lab., Upton, NY (United States). Apr 1992. DOE Contract AC05-84OR21400. (CONF-911079–Vol.3: 19. Nuclear Regulatory Commission (NRC) water reactor safety information meeting, Bethesda, MD (United States), 28-30 Oct 1991). In *Proceedings of the US Nuclear Regulatory Commission nineteenth water reactor safety information meeting. Volume 3, Structural engineering; Advanced reactor research; Advanced passive reactors; Human factors research; Human factors issues related to advanced passive LWRs; Thermal hydraulics; Earth sciences.* 542p. Source: OSTI; NTIS; INIS; GPO.

This paper summarizes research performed at Oak Ridge National Laboratory (ORNL) to assist the Nuclear Regulatory Commission (NRC) in preliminary determinations of licensability of the US Department of Energy (DOE) reference design of a standard modular high-temperature gas-cooled reactor (MHTGR). The work described includes independent analyses of core heatup and steam ingress accidents and the reviews and analyses of fuel performance and fission product transport technology.

3376 (NUREG/CP–0119-Vol.3, pp. 197-218) **Initial performance assessment of the Westinghouse AP600 containment design and related safety issues.** Tills, J.L. (Jack Tills and Associates, Inc., Sandia Park, NM (United States)); Washington, K.E.; Nicolette, V.F. Nuclear Regulatory Commission, Washington, DC (United States). Office of Nuclear Regulatory Research; Brookhaven National Lab., Upton, NY (United States). Apr 1992. DOE Contract AC04-76DP00789. (CONF-911079–Vol.3: 19. Nuclear Regulatory Commission (NRC) water reactor safety information meeting, Bethesda, MD (United States), 28-30 Oct 1991). In *Proceedings of the US Nuclear Regulatory Commission nineteenth water reactor safety information meeting. Volume 3, Structural engineering; Advanced reactor research; Advanced passive reactors; Human factors research; Human factors issues*

related to advanced passive LWRs; Thermal hydraulics; Earth sciences. 542p. Source: OSTI; NTIS; INIS; GPO.

The CONTAIN code is currently being used to predict containment thermal hydraulic conditions during design basis and severe accidents for advanced light water reactor (ALWR) designs such as the Westinghouse AP600. In the AP600 design, a passive containment cooling system (PCCS) is used for reducing long-term overpressure during accidents. CONTAIN models for heat and mass transfer within the AP600 containment and outer air cooling channel are verified by comparing recent CONTAIN calculations to integral test data obtained by Westinghouse in their PCCs Integral Test Facility. The comparison includes tests in which the outer containment wall is both dry and wet, that is, the wet tests involve an evaporative water film that enhances heat transfer as will be the case for AP600. The appropriateness of the heat and mass transfer analogy methodology used in the CONTAIN code is demonstrated. Code model limitations are discussed along with model development plans and applications for AP600.

3377 (NUREG/CP–0119-Vol.3, pp. 219-235) **An approach for assessing ALWR passive safety system reliability.** Hake, T.M. (Sandia National Labs., Albuquerque, NM (United States)). Nuclear Regulatory Commission, Washington, DC (United States). Office of Nuclear Regulatory Research; Brookhaven National Lab., Upton, NY (United States). Apr 1992. DOE Contract AC04-76DP00789. (CONF-911079–Vol.3: 19. Nuclear Regulatory Commission (NRC) water reactor safety information meeting, Bethesda, MD (United States), 28-30 Oct 1991). In *Proceedings of the US Nuclear Regulatory Commission nineteenth water reactor safety information meeting. Volume 3, Structural engineering; Advanced reactor research; Advanced passive reactors; Human factors research; Human factors issues related to advanced passive LWRs; Thermal hydraulics; Earth sciences.* 542p. Source: OSTI; NTIS; INIS; GPO.

Many advanced light water reactor designs incorporate passive rather than active safety features for front-line accident response. A method for evaluating the reliability of these passive systems in the context of probabilistic risk assessment has been developed at Sandia National Laboratories. This method addresses both the component (e.g. valve) failure aspect of passive system failure, and uncertainties in system success criteria arising from uncertainties in the system's underlying physical processes. These processes provide the system's driving force; examples are natural circulation and gravity-induced injection. This paper describes the method, and provides some preliminary results of application of the approach to the Westinghouse AP600 design.

3378 (NUREG/CP–0119-Vol.3, pp. 237-252) **Expanding the modeling capabilities of the cognitive environment simulation.** Roth, E.M. (Westinghouse Science and Technology Center, Pittsburgh, PA (United States)); Mumaw, R.J.; Pople, H.E. Jr. Nuclear Regulatory Commission, Washington, DC (United States). Office of Nuclear Regulatory Research; Brookhaven National Lab., Upton, NY (United States). Apr 1992. (CONF-911079–Vol.3: 19. Nuclear Regulatory Commission (NRC) water reactor safety information meeting, Bethesda, MD (United States), 28-30 Oct 1991). In *Proceedings of the US Nuclear Regulatory Commission nineteenth water reactor safety information meeting. Volume 3, Structural engineering; Advanced reactor research; Advanced passive reactors; Human factors research; Human factors issues related to advanced passive LWRs; Thermal hydraulics; Earth sciences.* 542p. Source: OSTI; NTIS; INIS; GPO.

The Nuclear Regulatory Commission has been conducting a research program to develop more effective tools to model the cognitive activities that underlie intention formation during nuclear power plant (NPP) emergencies. Under this program an artificial intelligence (AI) computer simulation called Cognitive Environment Simulation (CES) has been developed. CES simulates the cognitive activities involved in responding to a NPP accident situation. It is intended to provide an analytic tool for predicting likely human responses, and the kinds of errors that can plausibly arise under different accident conditions to support human reliability analysis. Recently CES was extended to handle a class of interfacing loss of coolant accidents (ISLOCAs). This paper summarizes the results of these exercises and describes follow-on work currently underway.

3379 (NUREG/CP–0119-Vol.3, pp. 253-261) **Human Performance Investigation Process (HPIP).** Paradies, M. (System Improvements, Inc., Knoxville, TN (United States)); Unger, L. Nuclear Regulatory Commission, Washington, DC (United States). Office of Nuclear Regulatory Research; Brookhaven National Lab., Upton, NY (United States). Apr 1992. (CONF-911079–Vol.3: 19. Nuclear Regulatory Commission (NRC) water reactor safety information meeting, Bethesda, MD (United States), 28-30 Oct 1991). In *Proceedings of the US Nuclear Regulatory Commission nineteenth water reactor safety information meeting. Volume 3, Structural engineering; Advanced reactor research; Advanced passive reactors; Human factors research; Human factors issues related to advanced passive LWRs; Thermal hydraulics; Earth sciences.* 542p. Source: OSTI; NTIS; INIS; GPO.

The nuclear power industry has gone through a transition from a period of plant construction to a period of plant operations. As the industry went through this transition, the US Nuclear Regulatory Commission (NRC) has likewise changed its regulatory emphasis. Today, with nuclear construction and licensing complete, the NRC is focusing on safe operation and maintenance of nuclear plants. This change in focus has caused the NRC's regulatory efforts to be less oriented toward design basis studies and more oriented toward operating experience and the human contribution to plant performance. Therefore, plant performance indicators and operational events now receive special attention. As increased attention is paid to human performance, its contribution to plant safety becomes more evident. This paper sets forth the goals of the Human Performance Investigation Process (HPIP), an investigation process being developed through the Human Factors Branch, Office of Nuclear Regulatory Research for use by US Nuclear Regulatory Commission personnel when investigating human performance related incidents at nuclear power plants. This paper describes HPIP's development, the HPIP process and techniques, and the testing of the process currently being performed.

3380 (NUREG/CP–0119-Vol.3, pp. 263-287) **Organizational factors influencing improvements in safety.** Marcus, A. (Univ. of Minnesota, Minneapolis (United States)); Nichols, M.L.; Olson, J.; Osborn, R.; Thurber, J. Nuclear Regulatory Commission, Washington, DC (United States). Office of Nuclear Regulatory Research; Brookhaven National Lab., Upton, NY (United States). Apr 1992. (CONF-911079–Vol.3: 19. Nuclear Regulatory Commission (NRC) water reactor safety information meeting, Bethesda, MD (United States), 28-30 Oct 1991). In *Proceedings of the US Nuclear Regulatory Commission nineteenth water reactor safety information meeting. Volume 3, Structural engineering; Advanced reactor research; Advanced passive reactors; Human factors research; Human factors issues related to advanced passive LWRs; Thermal hydraulics; Earth sciences.* 542p. Source: OSTI; NTIS; INIS; GPO.

Research reported here seeks to identify the key organizational factors that influence safety-related performance indicators in nuclear power plants over time. It builds upon organizational factors identified in NUREG/CR-5437, and begins to develop a theory of safety-related performance and performance improvement based on economic and behavioral theories of the firm. Central to the theory are concepts of past performance, problem recognition, resource availability, resource allocation, and business strategies that focus attention. Variables which reflect those concepts are combined in statistical models and tested for their ability to explain scrams, safety system actuations, significant events, safety system failures, radiation exposure, and critical hours. Results show the performance indicators differ with respect to the sets of variables which serve as the best predictors of future performance, and past performance is the most consistent predictor of future performance.

3381 (NUREG/CP–0119-Vol.3, pp. 289-300) **Including test errors in evaluating surveillance test intervals.** Kim, I.S. (Brookhaven National Lab., Upton, NY (United States)); Samanta, P.K.; Martorell, S.; Vesely, W.E. Nuclear Regulatory Commission, Washington, DC (United States). Office of Nuclear Regulatory Research; Brookhaven National Lab., Upton, NY (United States). Apr 1992. (CONF-911079–Vol.3: 19. Nuclear Regulatory Commission (NRC) water reactor safety information meeting, Bethesda, MD (United States), 28-30 Oct 1991). In *Proceedings of the US Nuclear Regulatory Commission nineteenth water reactor safety information*

meeting. Volume 3, Structural engineering; Advanced reactor research; Advanced passive reactors; Human factors research; Human factors issues related to advanced passive LWRs; Thermal hydraulics; Earth sciences. 542p. Source: OSTI; NTIS; INIS; GPO.

Technical Specifications require surveillance testing to assure that the standby systems important to safety will start and perform their intended functions in the event of plant abnormality. However, as evidenced by operating experience, the surveillance tests may adversely impact safety because of their undesirable side effects, such as initiation of plant transients during testing or wearing-out of safety systems du to testing. This paper first defines the concerns, i.e., the potential adverse effects of surveillance testing, from a risk perspective. Then, the authors present a methodology to evaluate the risk impact of those adverse effects, focusing on two important kinds of adverse impacts of surveillance testing: (1) risk impact of test-caused trips and (2) risk impact of test-caused equipment wear. The quantitative risk methodology is demonstrated with several surveillance tests conducted at boiling water reactors, such as the tests of the main steam isolation valves, the turbine overspeed protection system, and the emergency diesel generators. The authors present the results of the risk-effectiveness evaluation of surveillance test intervals, which compares the adverse risk impact with the beneficial risk impact of testing from potential failure detection, along with insights from sensitivity studies.

3382 (NUREG/CP–0119-Vol.3, pp. 309-327) **Verification and validation of expert systems.** Miller, L.A. (Science Applications International Corp., McLean, VA (United States)); Groundwater, E.; Mirsky, S. Nuclear Regulatory Commission, Washington, DC (United States). Office of Nuclear Regulatory Research; Brookhaven National Lab., Upton, NY (United States). Apr 1992. (CONF-911079–Vol.3: 19. Nuclear Regulatory Commission (NRC) water reactor safety information meeting, Bethesda, MD (United States), 28-30 Oct 1991). In *Proceedings of the US Nuclear Regulatory Commission nineteenth water reactor safety information meeting. Volume 3, Structural engineering; Advanced reactor research; Advanced passive reactors; Human factors research; Human factors issues related to advanced passive LWRs; Thermal hydraulics; Earth sciences.* 542p. Source: OSTI; NTIS; INIS; GPO.

The US Nuclear Regulatory Commission (NRC), and the Electric Power Research Institute (EPRI), have contracted with Science Applications International Corporation (SAIC) to develop guidelines for the verification and validation (V and V) of expert systems for use in the nuclear power industry. This paper reports first on the overall goals and tasks of this ongoing multi-year contract. The results of two completed task surveys are presented: (1) a survey of V and V techniques developed for conventional software and an assessment of their applicability to expert systems; and (2) a survey of activities and techniques actually used for the V and V of expert system, including automated tools. The paper concludes with discussion of likely directions for the remaining work.

3383 (NUREG/CP–0119-Vol.3, pp. 329-351) **A model for calculation of RCS pressure during reflux boiling under reduced inventory conditions and its assessment against PKL data.** Palmrose, D.E. (Idaho National Engineering Lab., Idaho Falls (United States)); Mandl, R.M. Nuclear Regulatory Commission, Washington, DC (United States). Office of Nuclear Regulatory Research; Brookhaven National Lab., Upton, NY (United States). Apr 1992. DOE Contract AC07-76ID01570. (CONF-911079–Vol.3: 19. Nuclear Regulatory Commission (NRC) water reactor safety information meeting, Bethesda, MD (United States), 28-30 Oct 1991). In *Proceedings of the US Nuclear Regulatory Commission nineteenth water reactor safety information meeting. Volume 3, Structural engineering; Advanced reactor research; Advanced passive reactors; Human factors research; Human factors issues related to advanced passive LWRs; Thermal hydraulics; Earth sciences.* 542p. Source: OSTI; NTIS; INIS; GPO.

There has been recent interest in the United States concerning the loss of residual heat removal system (RHRS) under reduced coolant inventory conditions for pressurized water reactors. This issue is also of interest in the Federal Republic of Germany and an experiment was performed in the integral PKL-III experimental facility at Siemens-KWU to supply applicable data. Recently, an NRC-sponsored effort has been undertaken at the Idaho National Engineering Laboratory to identify and analyze the important thermal-hydraulic phenomena in pressurized water reactors following the long term loss-of-RHRS during reduced inventory operation. The thermal-hydraulic response of a closed reactor coolant system during such a transient is investigated in this report. Some of the specific processes investigated include: reflux condensation in the steam generators, the corresponding pressure increase in the reactor coolant system, and void fraction distributions on the primary side of the system. Mathematical models of these and other physical processes were developed and assessed against the experimental data from the PKL III Experiment B4.5.

3384 (NUREG/CP–0119-Vol.3, pp. 353-365) **Effects of hydrogen generation on severe accident natural circulation.** O'Brien, J.E. (Idaho National Engineering Lab., Idaho Falls (United States)). Nuclear Regulatory Commission, Washington, DC (United States). Office of Nuclear Regulatory Research; Brookhaven National Lab., Upton, NY (United States). Apr 1992. (CONF-911079–Vol.3: 19. Nuclear Regulatory Commission (NRC) water reactor safety information meeting, Bethesda, MD (United States), 28-30 Oct 1991). In *Proceedings of the US Nuclear Regulatory Commission nineteenth water reactor safety information meeting. Volume 3, Structural engineering; Advanced reactor research; Advanced passive reactors; Human factors research; Human factors issues related to advanced passive LWRs; Thermal hydraulics; Earth sciences.* 542p. Source: OSTI; NTIS; INIS; GPO.

During certain pressurized water reactor (PWR) severe accident scenarios, natural circulation can play an important role in determining the failure location and time-to-failure of reactor coolant system (RCS) components. At the time in the transient when fuel cladding temperatures reach about 1,800 K, hydrogen generation due to the steam/zirconium reaction becomes significant. Effects of this hydrogen production on natural circulation flow and heat transfer have been considered in this report. Possible flow disruption due to hydrogen stratification in the reactor vessel and/or hydrogen-induced steam generator blockage were both considered. Long-term hydrogen stratification in the reactor vessel appears to be unlikely due to turbulent mixing associated with high Rayleigh number in-vessel natural convection. Mixing times scales were found to be very short, even when a fully stratified starting condition was assumed. This finding was consistent with experimental results obtained by Westinghouse with a 1/7-scale PWR RCS model. If mixing of steam and hydrogen is rapid and no condensation occurs, analysis of the accident progression can be performed by simply accounting for the properties of the gas mixture as the composition changes.

3385 (NUREG/CP–0119-Vol.3, pp. 367-384) **Scaling issues for a thermal-hydraulic integral test facility.** Boucher, T.J. (Idaho National Engineering Lab., Idaho Falls (United States)); Marzo, M. di; Shotkin, L.M. Nuclear Regulatory Commission, Washington, DC (United States). Office of Nuclear Regulatory Research; Brookhaven National Lab., Upton, NY (United States). Apr 1992. (CONF-911079–Vol.3: 19. Nuclear Regulatory Commission (NRC) water reactor safety information meeting, Bethesda, MD (United States), 28-30 Oct 1991). In *Proceedings of the US Nuclear Regulatory Commission nineteenth water reactor safety information meeting. Volume 3, Structural engineering; Advanced reactor research; Advanced passive reactors; Human factors research; Human factors issues related to advanced passive LWRs; Thermal hydraulics; Earth sciences.* 542p. Source: OSTI; NTIS; INIS; GPO.

The US Nuclear Regulatory Commission (USNRC) is considering how to best obtain integral system test data for the new reactors with passive safety systems, AP600 and simplified boiling water reactor (SBWR). This paper discusses scaling issues that must be considered in designing such a thermal-hydraulic integral test facility. Topics covered include experimental requirements for such a facility, a critical review of available scaling methodologies, experience from past testing programs which may aid the design of a new facility, enumeration of minimum dimensions for an integral test facility and application of these concepts to the design of a low pressure test facility.

3386 (NUREG/CP–0119-Vol.3, pp. 385-398) **Small break LOCA RELAP5/MOD3 uncertainty quantification: Bias and uncertainty evaluation for important phenomena.** Ortiz, M.G. (Idaho National Engineering Lab., Idaho Falls (United States));

Ghan, L.S.; Vogl, J. Nuclear Regulatory Commission, Washington, DC (United States). Office of Nuclear Regulatory Research; Brookhaven National Lab., Upton, NY (United States). Apr 1992. DOE Contract AC07-76ID01570. (CONF-911079–Vol.3: 19. Nuclear Regulatory Commission (NRC) water reactor safety information meeting, Bethesda, MD (United States), 28-30 Oct 1991). In *Proceedings of the US Nuclear Regulatory Commission nineteenth water reactor safety information meeting. Volume 3, Structural engineering; Advanced reactor research; Advanced passive reactors; Human factors research; Human factors issues related to advanced passive LWRs; Thermal hydraulics; Earth sciences.* 542p. Source: OSTI; NTIS; INIS; GPO.

The Nuclear Regulatory Commission (NRC) revised the Emergency Core Cooling System (ECCS) licensing rule to allow the use of Best Estimate (BE) computer codes, provided the uncertainty of the calculations are quantified and used in the licensing and regulation process. The NRC developed a generic methodology called Code Scaling, Applicability and Uncertainty (CSAU) to evaluate BE code uncertainties. The CSAU methodology was demonstrated with a specific application to a pressurized water reactor (PWR), experiencing a postulated large break loss-of-coolant accident (LBLOCA). The current work is part of an effort to adapt and demonstrate the CSAU methodology to a small break (SB) LOCA in a PWR of B and W design using RELAP5/MOD3 as the simulation tool. The subject of this paper is the Assessment and Ranging of Parameters, which determines the contribution to uncertainty of specific models in the code. In particular, the authors show the methodology used to assess the uncertainty of the specific models investigated. The authors have selected four phenomena of the highest importance to demonstrate the evaluation of bias and uncertainty; these are the break flow, natural circulation, decay power, and the temperature of the high pressure injection flow.

3387 (NUREG/CP–0119-Vol.3, pp. 399-436) **Universal treatment of plumes and stresses for pressurized thermal shock evaluations.** Theofanous, T.G. (Univ. of California, Santa Barbara (United States)); Angelini, S.; Yan, H. Nuclear Regulatory Commission, Washington, DC (United States). Office of Nuclear Regulatory Research; Brookhaven National Lab., Upton, NY (United States). Apr 1992. (CONF-911079–Vol.3: 19. Nuclear Regulatory Commission (NRC) water reactor safety information meeting, Bethesda, MD (United States), 28-30 Oct 1991). In *Proceedings of the US Nuclear Regulatory Commission nineteenth water reactor safety information meeting. Volume 3, Structural engineering; Advanced reactor research; Advanced passive reactors; Human factors research; Human factors issues related to advanced passive LWRs; Thermal hydraulics; Earth sciences.* 542p. Source: OSTI; NTIS; INIS; GPO.

The thermal field in a reactor vessel downcomer and resulting thermal/stress response in the adjacent reactor vessel wall during high-pressure safety injection are examined, especially with regard to departures from one-dimensional behavior. Similarity solutions for the stratification (in the cold leg) that creates the downcomer plumes, and scaling considerations for the thermal conduction and stress fields in the vessel wall are developed to provide generalized criteria for the adequacy of the one-dimensional treatment.

3388 (NUREG/CP–0119-Vol.3, pp. 301-307) **A performance indicator of the effectiveness of human-machine interfaces for nuclear power plants: Preliminary results.** Moray, N. (Univ. of Illinois, Urbana (United States)); Lee, J.; Vicente, K.J.; Jones, B.G.; Brock, R.; Djemil, T.; Rasmussen, J. Nuclear Regulatory Commission, Washington, DC (United States). Office of Nuclear Regulatory Research; Brookhaven National Lab., Upton, NY (United States). Apr 1992. (CONF-911079–Vol.3: 19. Nuclear Regulatory Commission (NRC) water reactor safety information meeting, Bethesda, MD (United States), 28-30 Oct 1991). In *Proceedings of the US Nuclear Regulatory Commission nineteenth water reactor safety information meeting. Volume 3, Structural engineering; Advanced reactor research; Advanced passive reactors; Human factors research; Human factors issues related to advanced passive LWRs; Thermal hydraulics; Earth sciences.* 542p. Source: OSTI; NTIS; INIS; GPO.

In this paper the authors report the results of experiments based on deGroot's work to assess the value of memory tests for measuring the quality of displays and the level of expertise of operators. Three kinds of display and people with three levels of expertise were included in the experiments. The displays were computer generated versions of traditional analog meters, traditional analog meters supplemented by a dynamic graphic representing the relation between temperature and pressure in some subsystems, and a dynamic graphic representing the underlying thermodynamics of power generation using the Rankine Cycle. The levels of expertise were represented by undergraduates with one semester of thermodynamics, graduate students of thermodynamics and nuclear engineering, and professional nuclear power plant operators. Each group watched a set of transients presented on the displays, using data generated by a high fidelity NPP training simulator, and were then asked three kinds of questions. The first measured their ability to recall the exact values of system state variables. The second measured their ability to recall what qualitative states the system had entered during the transient. The third measured their ability diagnose the nature of the transient. The results of the experiments are reported in relation to the possible use of memory tests to evaluate displays and the interaction of the quality of displays with the level of expertise of operators.

3389 (NUREG/CP–0119-Vol.3, pp. 437-461) **Liquefaction induced by modern earthquakes as a key to paleoseismicity: A case study of the 1988 Saguenay event.** Tuttle, M. (Lamont-Doherty Geological Observatory, Palisades, NY (United States)); Cowie, P.; Wolf, L. Nuclear Regulatory Commission, Washington, DC (United States). Office of Nuclear Regulatory Research; Brookhaven National Lab., Upton, NY (United States). Apr 1992. (CONF-911079–Vol.3: 19. Nuclear Regulatory Commission (NRC) water reactor safety information meeting, Bethesda, MD (United States), 28-30 Oct 1991). In *Proceedings of the US Nuclear Regulatory Commission nineteenth water reactor safety information meeting. Volume 3, Structural engineering; Advanced reactor research; Advanced passive reactors; Human factors issues related to advanced passive LWRs; Thermal hydraulics; Earth sciences.* 542p. Source: OSTI; NTIS; INIS; GPO.

Liquefaction features, including sand dikes, sills, and sand-filled craters, that formed at different distances from the epicenter of the 1988 (Mw 5.9) Saguenay earthquake are compared with one another and with older features. Modern liquefaction features decrease in size with increasing distance from the Saguenay epicenter. This relationship suggests that the size of liquefaction features may be used to determine source zones of past earthquakes and to estimate attenuation of seismic energy. Pre-1988 liquefaction features are cross-cut by the 1988 features. Although similar in morphology to the modern features, the pre-1988 features are more weathered and considerably larger in size. The larger pre-1988 features are located in the Ferland area, whereas the smallest pre-1988 feature occurs more than 37 km to the southwest. This spatial distribution of different size features suggests that an unidentified earthquake source zone (in addition to the one that generated the Saguenay earthquake) may exist in the Laurentide-Saguenay region. Structural relationships of the liquefaction features indicate that one, possibly two, earthquakes induced liquefaction in the region prior to 1988. The age of only one pre-1988 feature is well-constrained at 340 $\pm$ 70 radiocarbon years BP. If the 1663 earthquake was responsible for the formation of this feature, this event may have been centered in the Laurentide-Saguenay region rather than in the Charlevoix seismic zone.

3390 (NUREG/CP–0119-Vol.3, pp. 463-478) **High-precision accelerator-mass-spectrometer radiocarbon dating of buried tidal-marsh soils - An approach to estimating the frequency and coastal extent of subduction zone earthquakes in Oregon and Washington.** Nelson, A.R. (Geological Survey, Denver, CO (United States)); Ota, Yoko; Stafford, T.W. Jr.; Umitsu, Masatomo; Kashima, Kaoru; Matsushima, Yoshiaki. Nuclear Regulatory Commission, Washington, DC (United States). Office of Nuclear Regulatory Research; Brookhaven National Lab., Upton, NY (United States). Apr 1992. (CONF-911079–Vol.3: 19. Nuclear Regulatory Commission (NRC) water reactor safety information meeting, Bethesda, MD (United States), 28-30 Oct 1991). In *Proceedings of the US Nuclear Regulatory Commission nineteenth water reactor safety information meeting. Volume 3, Structural engineering; Advanced reactor research; Advanced passive reactors;*

Human factors research; Human factors issues related to advanced passive LWRs; Thermal hydraulics; Earth sciences. 542p. Source: OSTI; NTIS; INIS; GPO.

Accurate and precise radiocarbon dating of buried tidal-marsh soils in estuarine stratigraphic sequences in the Pacific Northwest can help distinguish soils submerged during regional plate-boundary earthquakes from soils submerged during local upper-plate earthquakes or by non-tectonic processes. More precise ages than those resulting from conventional methods of radiocarbon analysis can be obtained by averaging multiple accelerator-mass-spectrometer (AMS) ^{14}C ages of rigorously selected and pretreated plant macrofossils at the abrupt upper contacts of tidal-marsh soils. An initial test of this method in Coos Bay, Oregon, shows that standard deviations on AMS ages can be reduced to $\pm$ 25-40 radiocarbon years. But consideration of the total analytical errors in AMS analysis and age differences due to variations in the rate of ^{14}C production in the atmosphere over time indicate that 95% confidence limits on calendar-corrected ages for submergence events range from 50 to 450 years.

3391 (NUREG/CP–0119-Vol.3, pp. 479-499) **Soil/structure interactions of eastern US type earthquakes.** Chang Chen (Gilbert/Commonwealth, Inc., Reading, PA (United States)); Serhan, S.J. Nuclear Regulatory Commission, Washington, DC (United States). Office of Nuclear Regulatory Research; Brookhaven National Lab., Upton, NY (United States). Apr 1992. (CONF-911079–Vol.3: 19. Nuclear Regulatory Commission (NRC) water reactor safety information meeting, Bethesda, MD (United States), 28-30 Oct 1991). In *Proceedings of the US Nuclear Regulatory Commission nineteenth water reactor safety information meeting. Volume 3, Structural engineering; Advanced reactor research; Advanced passive reactors; Human factors research; Human factors issues related to advanced passive LWRs; Thermal hydraulics; Earth sciences.* 542p. Source: OSTI; NTIS; INIS; GPO.

This paper presents analyses and conclusions pertaining to the earthquake motions felt at Virgil C. Summer, Perry and Krsko nuclear power plants. Consideration is given to promote an improved understanding of these events, describe common characteristics, assess damage potential, and recommend operating procedures for similar future events. An easy-to-follow analytical investigation is performed to describe how the earthquakes recorded at Krsko may be influenced by soil/structure interaction including a few parametric studies to account for uncertainties in the soil properties. These consist of variations in the shear and compressional wave velocities and variations in the seismic wave environment in the form of arbitrarily oriented body waves or Rayleigh waves. The analysis takes into account nonlinearity of the soil material, radiation and hysteretic damping, ground-water table level, structural embedment, and structure/structure interaction. The analysis is based on state-of-the-art computer software, elaborate analysis techniques and simpler engineering approximations. Results of analysis show clear evidence of soil/structure interaction, nonlinear softening of the soil material and encouraging qualitative and quantitative agreement with the recorded measurements. The structural response motions display high rocking mode.

3392 (NUREG/CP–0119-Vol.3, pp. 501-520) **A basis for standardized seismic design (SSD) for nuclear power plants.** O'Hara, T.F. (Yankee Atomic Electric Co., Bolton, MA (United States)); Jacobson, J.P.; Bellini, F.X.; Briggs, W.J. Nuclear Regulatory Commission, Washington, DC (United States). Office of Nuclear Regulatory Research; Brookhaven National Lab., Upton, NY (United States). Apr 1992. (CONF-911079–Vol.3: 19. Nuclear Regulatory Commission (NRC) water reactor safety information meeting, Bethesda, MD (United States), 28-30 Oct 1991). In *Proceedings of the US Nuclear Regulatory Commission nineteenth water reactor safety information meeting. Volume 3, Structural engineering; Advanced reactor research; Advanced passive reactors; Human factors research; Human factors issues related to advanced passive LWRs; Thermal hydraulics; Earth sciences.* 542p. Source: OSTI; NTIS; INIS; GPO.

US nuclear power plants (NPPs) are designed, engineered, and constructed to stringent standards. Their seismic adequacy is assured by compliance with regulatory standards and demonstrated by both probabilistic risk assessments (PRAs) and seismic margin studies. However, present seismic siting criteria require fundamental changes in both the philosophy of how the rule should be written and in the actual application of a process to determine acceptable seismic design levels. Changes to siting criteria proposed here provides a predictable licensing process and a stable regulatory environment. Two recent state-of-the-art studies evaluate the seismic design for all eastern US (EUS) NPPs: a Lawrence Livermore National Labs study (LLNL, 1989) funded by the NRC and similar research by the Electric Power Research Institute (EPRI, 1989) supported by the utilities. Both confirm that Appendix A 10CFR100 has not provided consistent seismic design levels for all sites. Standardized Seismic Design (SSD) uses a probabilistic framework to accommodate alternative deterministic interpretations. It uses seismic hazard input from EPRI or LLNL to produce consistent bases for future seismic design. SSD combines deterministic and probabilistic insights to provide a comprehensive approach for determining a future site's acceptable seismic design basis. The essence of this approach is the calibration of a seismic hazard methodology to a common standard.

3393 (NUREG/CP–0120, pp. 17-20) **Opening remarks.** Selin, I. (Nuclear Regulatory Commission, Washington, DC (United States)). Nuclear Regulatory Commission, Washington, DC (United States). Div. of Engineering; Sandia National Labs., Albuquerque, NM (United States). Jul 1992. (SAND–92-0173;CONF-920541–: 5. workshop on containment integrity for nuclear power plants, Washington, DC (United States), 12-14 May 1992). In *Proceedings of the fifth workshop on containment integrity.* 646p. Source: OSTI; NTIS; INIS; GPO.

Since the Three Mile Island unit 2 reactor accident the U.S. Nuclear Regulatory Commission (NRC) has increasingly emphasized the need to understand the variety of containment challenges that could occur as a result of a severe core damage accident. The focus of this effort has been on those containment challenges where the resultant pressure and temperature conditions could threaten the integrity of the containment building. Research is focused largely on understanding containment capabilities and the margins in performance that go beyond design loads and severe core damage threats in five specific areas: combinations of pressure and temperature that could lead to the failure of the containment pressure boundary, timing of containment failure in the accident sequence, failure mode, leak area and the associated leak rate, and the location of the failure. Considerable effort is being devoted to the containment issues of the next generation of advanced light water reactors whose designs have been or will be submitted to the NRC for certification.

3394 (NUREG/CP–0120, pp. 21-29) **Containment severe accident phenomenology.** Speis, T. (Nuclear Regulatory Commission, Washington, DC (United States)); Eltawila, F. Nuclear Regulatory Commission, Washington, DC (United States). Div. of Engineering; Sandia National Labs., Albuquerque, NM (United States). Jul 1992. (SAND–92-0173;CONF-920541–: 5. workshop on containment integrity for nuclear power plants, Washington, DC (United States), 12-14 May 1992). In *Proceedings of the fifth workshop on containment integrity.* 646p. Source: OSTI; NTIS; INIS; GPO.

The role of the containment as a vital barrier to the release of fission products to the environment has been widely recognized. The public safety record of nuclear power plants has been fostered by applying the defense-in-depth principle, which relies on a set of independent barriers to fission products release. The containment and its supporting systems are one of these barriers. The author summarizes the conditions which containments should be evaluated against for the purpose of either understanding the margins of the existing generation of containment systems or to develop performance criteria for future plants against severe accident challenges. The paper specifically discusses containment loading in severe accidents, initial and boundary conditions, fuel-coolant interactions, hydrogen deflagration and detonation, core-concrete interaction and debris coolability, severe accident rulemaking.

3395 (NUREG/CP–0120, pp. 31-34) **Proposed criteria to accommodate severe accidents in containment design.** Ward, D.A. (Advisory Committee on Reactor Safeguards, Washington, DC (United States)). Nuclear Regulatory Commission, Washington, DC

(United States). Div. of Engineering; Sandia National Labs., Albuquerque, NM (United States). Jul 1992. (SAND–92-0173;CONF-920541–: 5. workshop on containment integrity for nuclear power plants, Washington, DC (United States), 12-14 May 1992). In *Proceedings of the fifth workshop on containment integrity*. 646p. Source: OSTI; NTIS; INIS; GPO.

The paper discusses the role of the Advisory Committee on Reactor Safeguards (ACRS), observations made by the ACRS committee and presented to the Nuclear Regulatory Commission (NRC) on existing containment requirements, recommendations of the committee as to what should be done by the NRC to deal with the committee's concerns, the proposed regulatory program including General Design Criteria and other Regulatory Guide modifications, and what the NRC is doing to address the observations and recommendations made by the ACRS.

3396 (NUREG/CP–0120, pp. 37-50) **A review of containment accidents.** Boeck, B. de (AIB-Vincotte Nucleaire, Brussels (Belgium)). Nuclear Regulatory Commission, Washington, DC (United States). Div. of Engineering; Sandia National Labs., Albuquerque, NM (United States). Jul 1992. (SAND–92-0173;CONF-920541–: 5. workshop on containment integrity for nuclear power plants, Washington, DC (United States), 12-14 May 1992). In *Proceedings of the fifth workshop on containment integrity*. 646p. Source: OSTI; NTIS; INIS; GPO.

The consequences of severe reactor accidents depend greatly on containment safety features and containment performance in retaining radioactive material. If the containment function is maintained in a severe accident, the radiological consequences will be minor. If the containment function does fail, the timing of failure can be very important. The longer the containment remains intact relative to the time of core melting and radionuclide release from the reactor coolant system, the more time is available to remove radioactive material from the containment atmosphere by engineered safety features or natural deposition processes. Delay in containment failure or containment bypass also provides time for protective action, a very important consideration in the assessment of possible early health effects. Thus, in evaluating the performance of a containment, it is convenient to consider no failure, early failure, late failure, and containment bypass as separate categories characterizing different degrees of severity. The paper reviews the containment challenges posed by the severe accidents, on the basis of an extensive list of references. First the phenomena that could lead to early containment failure are described: direct containment heating, steam explosions, hydrogen combustion, and isolation failures. Then the late containment failure modes are treated: gradual overpressurization, basemat meltthrough, and overheating. Finally, some words are said about containment bypass.

3397 (NUREG/CP–0120, pp. 51-60) **Deterministic Severe Accident Criteria (DSACs) as severe accident design criteria and policy for the new production reactor - heavy water reactor.** Rhoads, P.T. (Department of Energy, Washington, DC (United States)). Nuclear Regulatory Commission, Washington, DC (United States). Div. of Engineering; Sandia National Labs., Albuquerque, NM (United States). Jul 1992. (SAND–92-0173;CONF-920541–: 5. workshop on containment integrity for nuclear power plants, Washington, DC (United States), 12-14 May 1992). In *Proceedings of the fifth workshop on containment integrity*. 646p. Source: OSTI; NTIS; INIS; GPO.

One of the most important functions that a nuclear containment serves is to protect the public from the radiological consequences of severe accidents, i.e., those beyond design basis events which result in significant core damage. However, the design basis and design processes for light water containments have not generally been explicitly linked to accommodating these extreme events into the containment design. For light water reactors, the containment design basis has been based on considerations other than severe accidents, such as the consideration of the containment pressurization due to a loss of coolant accident. The resulting containment designs for certain pressurized light water reactors were then assessed and shown to have adequate resistance to severe accidents. The light water reactor containment design basis would not be directly applicable for the New Production Reactor-Heavy Water Reactor (NPR-HWR) because of the low stored energy of the Heavy Water Reactor. The Department of Energy's Office of New Production Reactors (NP) established as a fundamental point of policy that the NPR-HWR containment would be designed under the following requirements: The NPR-HWR containment would be designed to accommodate hypothetical severe accident challenges. A full-scope probabilistic analysis of reactor operations, including severe accidents, would be performed to complement deterministic analyses and demonstrate containment adequacy. The defense-in-depth philosophy would be fully integrated into the containment design. The implementation of these and other requirements relevant to the containment design basis is being accomplished in a systematic manner for the NPR-HWR.

3398 (NUREG/CP–0120, pp. 61-80) **Proposed Deterministic Severe Accident Criteria for the heavy water new production reactor containment.** Bergeron, K.D. (Sandia National Lab., Albuquerque, NM (United States)); Slezak, S.E.; Leach, C.E. Nuclear Regulatory Commission, Washington, DC (United States). Div. of Engineering; Sandia National Labs., Albuquerque, NM (United States). Jul 1992. DOE Contract AC04-76DP00789. (SAND–92-0173;CONF-920541–: 5. workshop on containment integrity for nuclear power plants, Washington, DC (United States), 12-14 May 1992). In *Proceedings of the fifth workshop on containment integrity*. 646p. Source: OSTI; NTIS; INIS; GPO.

This paper summarizes the methodology develop by the Deterministic Severe Accident Criteria (DSAC) Development Project to assist the Department of Energy's (DOE) Office of Heavy Water Reactor in formulating containment design criteria for the New Production Reactor-Heavy Water Reactor (NPR-HWR) that are a practical implementation of high-level programmatic goals. The design criteria, represent a new approach because they address severe accidents early in the design phase of the nuclear plant. This paper describes a process and approach that considers severe accidents in containment design by establishing practical design requirements based on calculation of stylized loads on the containment. The DSAC Development Project utilized a formal expert opinion process to provide a quantitative specification of the severity of the loads and reviewable technical basis. The goals for the project were to (1) generate specific proposals for quantitative criteria within the specified project schedule, (2) minimize the phenomenological uncertainty residing in the problem statements and success criteria so that the design's compliance with the criteria would not be the subject of protracted contention, (3) follow a formal plan consisting of well-defined steps, each of which was scrutable and reviewable, (4) ensure that the complete spectrum of credible severe accident threats was covered by the criteria, and (5) avoid over-constraining the design. As a result of the output of this process, the DOE's Office of Heavy Water Reactor was able to integrate the project recommendations together with numerous other inputs to promulgate design criteria that were conservative, but not excessively so, and that could be technically reviewed and defended.

3399 (NUREG/CP–0120, pp. 81-108) **A generic approach for containment success criteria under severe accident loads.** Sammataro, R.F. (General Dynamics Corp., Groton, CT (United States)); Solonick, W.R.; Edwards, N.W. Nuclear Regulatory Commission, Washington, DC (United States). Div. of Engineering; Sandia National Labs., Albuquerque, NM (United States). Jul 1992. (SAND–92-0173;CONF-920541–: 5. workshop on containment integrity for nuclear power plants, Washington, DC (United States), 12-14 May 1992). In *Proceedings of the fifth workshop on containment integrity*. 646p. Source: OSTI; NTIS; INIS; GPO.

The U.S. Department of Energy (DOE), Office of New Production Reactors (NP), has identified safety as the foremost design criterion for the Heavy Water New Production Reactor (NPR-HWR). The DOE-NP has issued the Deterministic Severe Accident Criteria (DSACs) to guide the design of the NPR-HWR containment for resistance to severe accidents. The DSAC concept provides for a generic approach for success criteria to predict the threshold of containment failure under severe accident loads. This concept consists of two parts: (1) Problem Statements that are qualitative and quantitative bases for calculating associated loadings and containment response to those loadings, and (2) Success Criteria that

specify acceptable containment response measures and limits for each problem statement. This paper is limited to a discussion of a generic approach for containment success criteria. The main elements of these success criteria are expressed in terms of elastic stresses and inelastic strains. Containment performance is based on the best estimate of failure as predicted by either stress or strain, buckling, displacements, or ability to withstand missile perforation. Since these limits are best estimates of failure, no conservatism exists in these success criteria. Rather, conservatism is to be provided in the problem statements, i.e., the quantified severe accident loads. These success criteria are presented on a multi-tiered basis for static pressure and temperature loadings, dynamic loadings, and missiles. Within the static pressure and temperature loadings and the dynamic loadings, the criteria are separated into elastic analysis success criteria and inelastic analysis success criteria. Each of these areas, in turn, defines limits on either the stress or strain measures as well as on measures for buckling and displacements.

3400 (NUREG/CP–0120, pp. 111-132) **ALWR utility requirements document containment performance requirements.** Leaver, D.E. (TENERA, L.P., Bethesda, MD (United States)); Addition, S.L. Nuclear Regulatory Commission, Washington, DC (United States). Div. of Engineering; Sandia National Labs., Albuquerque, NM (United States). Jul 1992. (SAND–92-0173;CONF-920541–: 5. workshop on containment integrity for nuclear power plants, Washington, DC (United States), 12-14 May 1992). In *Proceedings of the fifth workshop on containment integrity.* 646p. Source: OSTI; NTIS; INIS; GPO.

U.S. utilities, with substantial support from international utilities, are leading the industry-wide Advanced Light Water Reactor (ALWR) Program. This program is establishing a technical foundation for the next generation of LWRs through development of a comprehensive set of design requirements for the ALWR in the form of a Utility Requirements Document (URD). The approach in the URD for severe accidents involved two main efforts: (1) accident prevention through intrinsic design characteristics to avoid accident initiation and reliable, engineered safety systems to prevent core damage, and (2) accident mitigation and containment performance. The purpose of this paper is to describe the URD containment performance requirements for severe accidents. For containment performance, a comprehensive set of severe accident containment challenges was defined and a matrix of design features and operating characteristics specified to address the challenges. Also, the URD requires evaluation of containment response to severe accidents. Twenty-three severe accident containment challenges were identified and a preliminary evaluation of the URD indicated that requirements are adequate for addressing each of the challenges. Further, best estimate severe accident evaluations for the ALWR containment indicate that margin exists to ASME Service Level C limits and this containment leakage during severe accidents should be minimal. An updated accident source term was also developed by the ALWR Program to provide an improved design basis for fission product mitigation system design.

3401 (NUREG/CP–0120, pp. 135-150) **Study of potential design margins in the codes of practice for structural design of primary containment.** Ray, S.S. (Taywood Engineering Ltd., Southall, Middlesex (United Kingdom)). Nuclear Regulatory Commission, Washington, DC (United States). Div. of Engineering; Sandia National Labs., Albuquerque, NM (United States). Jul 1992. (SAND–92-0173;CONF-920541–: 5. workshop on containment integrity for nuclear power plants, Washington, DC (United States), 12-14 May 1992). In *Proceedings of the fifth workshop on containment integrity.* 646p. Source: OSTI; NTIS; INIS; GPO.

The structural designs of nuclear power stations all over the world have been carried out using a variety of codes of practice with hardly any uniformity. This may have given rise to primary containment structures with varying degrees of margin against failure. It is fruitless to argue about the appropriateness of the various provisions in codes of practice for design and analyses formulated by different committees in different countries. In this paper a method to find the available margin against collapse is defined without making any reference to the codes of practice used in the original design of the containment structure. A structured step-by-step method is suggested which can be universally applied irrespective of the location, condition, age or type of primary containment. The three key factors in a containment structure are the geometry, the material properties and the loading. Coupled with these there are two further aspects namely, the condition of the structure and the efficiency of the method of finding the available margin. The whole process is based on the broad philosophy of assessment of existing structures where the geometric and material variabilities assumed at the design stage have been considerably narrowed down and most of the analytical conservatisms removed by the application of state-of-the-art computer software and parametric studies.

3402 (NUREG/CP–0120, pp. 151-162) **Design considerations for concrete containments under severe accident loads.** Amin, M. (Sargent and Lundy Engineers, Chicago, IL (United States)); Eberhardt, A.C.; Erler, B.A. Nuclear Regulatory Commission, Washington, DC (United States). Div. of Engineering; Sandia National Labs., Albuquerque, NM (United States). Jul 1992. (SAND–92-0173;CONF-920541–: 5. workshop on containment integrity for nuclear power plants, Washington, DC (United States), 12-14 May 1992). In *Proceedings of the fifth workshop on containment integrity.* 646p. Source: OSTI; NTIS; INIS; GPO.

Current light water reactor containments have been shown to accommodate credible severe accident loads. Future containments should be explicitly designed for severe accident loads to address the uncertainty associated with the response of containments to these low-probability events. This paper examines the experiences from the application of current structural design codes for concrete containments, ultimate pressure capacity evaluation of existing containments, and pressure fragility testing of scale model concrete containments to arrive at the directions for modification of national codes. Recommendations are provided to consider the severe accidents directly in the concrete containment design.

3403 (NUREG/CP–0120, pp. 163-178) **Design bases and severe accident considerations for the System 80+ ™ containment design.** Schneider, R.E. (ABB-Combustion Engineering, Inc., Windson, CT (United States)); Gerdes, L.D.; Oswald, J.T.; Snipes, J.F. Jr. Nuclear Regulatory Commission, Washington, DC (United States). Div. of Engineering; Sandia National Labs., Albuquerque, NM (United States). Jul 1992. (SAND–92-0173;CONF-920541–: 5. workshop on containment integrity for nuclear power plants, Washington, DC (United States), 12-14 May 1992). In *Proceedings of the fifth workshop on containment integrity.* 646p. Source: OSTI; NTIS; INIS; GPO.

Containments for Advanced Light Water Reactors (ALWRs) must not only be designed for design bases conditions but also be evaluated for postulated severe accident concerns. This paper presents the containment design description for the System 80+ ALWR, the conservative design bases specified and the System 80+ ALWR design features to prevent and mitigate the challenges considered in postulated severe accident scenarios. Included in the containment design bases are postulated primary and secondary pipe break conditions and seismic requirements for an envelope of site conditions with a control motion having much higher energy content than those used for existing reactor designs. Severe accident considerations addressed include prevention and mitigation design features incorporated into the System 80+ ALWR.

3404 (NUREG/CP–0120, pp. 179-189) **Comparison of the Westinghouse-GOTHIC containment code predictions to PCCS test results.** Kennedy, M.D. (Westinghouse Electric Corp., Pittsburgh, PA (United States)); Woodcock, J. Nuclear Regulatory Commission, Washington, DC (United States). Div. of Engineering; Sandia National Labs., Albuquerque, NM (United States). Jul 1992. (SAND–92-0173;CONF-920541–: 5. workshop on containment integrity for nuclear power plants, Washington, DC (United States), 12-14 May 1992). In *Proceedings of the fifth workshop on containment integrity.* 646p. Source: OSTI; NTIS; INIS; GPO.

The computer code calculations which are reported herein examine integral tests of a steel vessel with internal steam condensation and external heat removal by natural convection from a dry surface. Several of the advanced nuclear plant concepts utilize a passive containment cooling system (PCCS) to remove the heat

released to containment following postulated events such as a loss of coolant accident. Such a system employs passive or natural draft air cooling to transfer heat from the steel containment vessel to the environment. This process is simulated in the tests with a steel vessel and natural convection annular air flow. Heat is delivered to the vessel using superheated steam. Results of test simulations with a computer code are shown. A methodology is presented which includes mechanistic heat and mass transfer correlations, including wall-to-wall radiant heat transfer. A dynamic stratification of internal non-condensable gases is shown to explain the axial wall temperature distributions.

3405 (NUREG/CP–0120, pp. 191-226) **SBWR reinforced concrete containment structural performance during severe accident.** Orsini, G. (ENEA-Disp, Rome (Italy)); Pino, G. Nuclear Regulatory Commission, Washington, DC (United States). Div. of Engineering; Sandia National Labs., Albuquerque, NM (United States). Jul 1992. (SAND–92-0173;CONF-920541–: 5. workshop on containment integrity for nuclear power plants, Washington, DC (United States), 12-14 May 1992). In *Proceedings of the fifth workshop on containment integrity.* 646p. Source: OSTI; NTIS; INIS; GPO.

The Simplified Boiling Water Reactor (SBWR) reinforced concrete containment structure is analyzed for its ultimate internal pressure capability under slow pressurization and the associated temperature loads in case of severe accident. In the first phase of the analysis an axisymmetric Finite Element model has been considered with an increasing internal pressure without temperature effects; in the second phase a temperature transient load has been applied to the structure before pressurization. Major topics of the performed analysis have been addressed, with emphasis on the failure criteria applicable to reinforced concrete structure.

3406 (NUREG/CP–0120, pp. 227-243) **Post-test analysis of a 1:10-scale top slab model of ABWR/RCCV subjected to internal pressure.** Saito, Hideaki (Tokyo Electric Power Co., Inc. (Japan)); Muramatsu, Yutaka; Furukawa, Hideyasu; Hasegawa, Toshiyasu; Mutoh, Atsushi. Nuclear Regulatory Commission, Washington, DC (United States). Div. of Engineering; Sandia National Labs., Albuquerque, NM (United States). Jul 1992. (SAND–92-0173;CONF-920541–: 5. workshop on containment integrity for nuclear power plants, Washington, DC (United States), 12-14 May 1992). In *Proceedings of the fifth workshop on containment integrity.* 646p. Source: OSTI; NTIS; INIS; GPO.

The first Advanced Boiling Water Reactor (ABWR) employing a reinforced concrete containment vessel (RCCV) has started its construction in 1991 in Japan. As RCCV itself is the first structure of its kind in Japan, thorough verification tests have been performed. This paper presents the results of simulation analysis of the top slab partial model of the RCCV subjected to internal pressure beyond design load. Top slab portion is so complicated, composed of flat top slab, cylindrical wall and fuel pool girders, that its simulation analysis requires the evaluation of nonlinear structural behavior of reinforced concrete members due to membrane, bending and shear forces. This paper reports that finite element analysis with 3-dimensional solid approach has given a good agreement quantitatively between experimental and analysis results with respect to deformation, failure load and each nonlinear behaviors.

3407 (NUREG/CP–0120, pp. 247-269) **L.I.R.A.: An advanced containment system to minimize the accidental radioactivity releases.** Turricchia, A. (ENEL-DCO, Roma (Italy)). Nuclear Regulatory Commission, Washington, DC (United States). Div. of Engineering; Sandia National Labs., Albuquerque, NM (United States). Jul 1992. (SAND–92-0173;CONF-920541–: 5. workshop on containment integrity for nuclear power plants, Washington, DC (United States), 12-14 May 1992). In *Proceedings of the fifth workshop on containment integrity.* 646p. Source: OSTI; NTIS; INIS; GPO.

A containment system named L.I.R.A. has been studied for advanced PWRs with the general design objective of limiting the accidental radioactivity release to the environment to less than one millionth of core inventory (of cesium, iodine and other aerosols), by using substantially passive features. The intent is to avoid, even in case of severe accident, the evacuation of the population living near the nuclear power plant and to limit the contamination of the surrounding territory to such low values as to permit its continued and unrestricted use after the accident. The design objective has been achieved by adopting the vapor suppression principle, with a drywell concentric with the wetwell, but still retaining a large and strong containment. The integrity and leaktightness of the containment is preserved against all the challenges posed by severe accidents by: making the suppression pool large enough to be able to absorb, without boiling, all the heat inputs generated in the first 24 hours; burning the hydrogen as it emerges without steam above the suppression pool, by means of D.C. powdered spark ignitors backed up by passive catalytic recombiners located near the top of the containment dome; and locating, in the dry cavity below the pressure vessel, a stack of staggered graphite beams which causes the dispersion and solidification of the molten core in thin layers. After corium solidification, water from the suppression pool is allowed to flood gradually the cavity.

3408 (NUREG/CP–0120, pp. 271-283) **Design of the internal geometry of an advanced containment for mitigating deflagration overpressures.** Carcassi, M.N. (Univ. of Pisa (Italy)); Fineschi, F. Nuclear Regulatory Commission, Washington, DC (United States). Div. of Engineering; Sandia National Labs., Albuquerque, NM (United States). Jul 1992. (SAND–92-0173;CONF-920541–: 5. workshop on containment integrity for nuclear power plants, Washington, DC (United States), 12-14 May 1992). In *Proceedings of the fifth workshop on containment integrity.* 646p. Source: OSTI; NTIS; INIS; GPO.

During a severe accident at a light water reactor nuclear power plant, there is the potential for the generation, accumulation and combustion of hydrogen. Various models and computer codes have been developed to predict the containment loading that may result from the maximum overpressures generated from the combustion of hydrogen during a severe accident. In the first phase of the research, the DEVENT code was developed as an analytical tool to provide a more realistic evaluation of the maximum overpressures reached in the compartments as a result of deflagration. DEVENT simulates the deflagration transient in a compartment with venting towards a constant pressure environment. Deflagration tests where carried out in a partially contained volume in the HYDRO apparatus (0.5 m^3 steel vessel) and in the VIEW (0.4 m^3 glass vessel) apparatus, where the flame front can be seen with the addition of a NaCl aerosol. The preliminary data that has been generated from the theoretical and experimental result, on the optimum collocation of venting apertures and igniters, can be used to develop of igniters or other systems, which address hydrogen mitigation in advance type containments.

3409 (NUREG/CP–0120, pp. 285-303) **Studies on ALWR's containment system penetration.** Mantega, F. (CISE, Milano (Italy)); Penno, E.; Vanini, P. Nuclear Regulatory Commission, Washington, DC (United States). Div. of Engineering; Sandia National Labs., Albuquerque, NM (United States). Jul 1992. (SAND–92-0173;CONF-920541–: 5. workshop on containment integrity for nuclear power plants, Washington, DC (United States), 12-14 May 1992). In *Proceedings of the fifth workshop on containment integrity.* 646p. Source: OSTI; NTIS; INIS; GPO.

The reduction of the radioactive release during a light water reactor severe accident can be achieved by improving some precise plant requirements, among which the containment leaktightness to the environment. One of the critical points of this matter is due to the containment penetrations. The SANDIA/NUREG experience on the Callaway-2 personnel airlock showed good behavior of the whole component as for pressure and, in some way, temperature. Starting from this experience studies are in progress in order to explore the possibility of realizing a mitigation of the thermal load of the elastomered sealing area of both personnel airlocks and equipment hatches during a long-term severe accident. These studies, performed on one of the ALWR design concept, also regard the mechanical and thermal stress behaviors of these components as integrate. On the basis of the currently used elastomers, the paper deals with new arrangements to passively improve the component performances in case of severe accident conditions. Calculations performed on a Personnel Airlock show that it can be possible to assure less than 170 C of the outer door temperature and 355 C at the inner door while the containment temperature would be more

than 450 C by passively improving heat dissipation and thermal insulation. About the Equipment Hatch which, because of its position, represents the weak point of the whole Containment barrier it is worth noticing that the double-seal arrangement does not represent a redundant feature due to the closeness of the two gaskets. Modifications of this component are being studied to give rise to an independent sealing area far enough from the main one to assure milder radiation and thermal conditions for the elastomer even in a severe accident scenario. An experimental campaign is expected to be performed in the future on a personnel airlock in a canceled power station.

3410 (NUREG/CP–0120, pp. 305-321) **Severe accident risk minimization studies for the Advanced Neutron Source (ANS) reactor plant at the Oak Ridge National Laboratory.** Taleyarkhan, R.P. (Martin Marietta Energy Systems, Inc., Oak Ridge, TN (United States)); Kim, Seok-Ho. Nuclear Regulatory Commission, Washington, DC (United States). Div. of Engineering; Sandia National Labs., Albuquerque, NM (United States). Jul 1992. (SAND–92-0173;CONF-920541–: 5. workshop on containment integrity for nuclear power plants, Washington, DC (United States), 12-14 May 1992). In *Proceedings of the fifth workshop on containment integrity.* 646p. Source: OSTI; NTIS; INIS; GPO.

This paper discusses salient aspects of severe accident related phenomenological considerations, scoping studies, and mitigative design features being studied for incorporation into a higher-power research reactor plant. Key results of scoping studies on steam explosions, recriticality, core-concrete interactions, and containment transport are highlighted. Evolving design features of the containment are described. Containment response calculations for a site-suitability basis transient are presented that demonstrate acceptable source term values and superior containment performance.

3411 (NUREG/CP–0120, pp. 323-335) **Extreme loadings of inner structures of next generation PWR containments.** Krieg, R. (Kernforschungszentrum Karlsruhe (Germany)); Alsmeyer, H.; Jacobs, G.; Jacobs, H.; Eibl, J.; Schlueter, F.H.; Klatte, T. Nuclear Regulatory Commission, Washington, DC (United States). Div. of Engineering; Sandia National Labs., Albuquerque, NM (United States). Jul 1992. (SAND–92-0173;CONF-920541–: 5. workshop on containment integrity for nuclear power plants, Washington, DC (United States), 12-14 May 1992). In *Proceedings of the fifth workshop on containment integrity.* 646p. Source: OSTI; NTIS; INIS; GPO.

Advanced safety demands call for pressurized water reactor containments which are able to withstand any conceivable accident including the different types of core melt down accidents. The necessary improvements for the inner structures of the containments are discussed. Extreme loadings of these structures such as an in-vessel steam explosion and a melt-through-failure of the reactor vessel under high pressure must not endanger the containment. The ongoing research work to show this is described.

3412 (NUREG/CP–0120, pp. 337-363) **An improved design concept for next generation PWR containments.** Eibl, J. (Consulting Engineers, Karlsruhe (Germany)); Schlueter, F.H.; Klatte, T.; Breitung, W.; Erbacher, F.; Goeller, B.; Krieg, R.; Scholtyssek, W.; Wilhelm, J. Nuclear Regulatory Commission, Washington, DC (United States). Div. of Engineering; Sandia National Labs., Albuquerque, NM (United States). Jul 1992. (SAND–92-0173;CONF-920541–: 5. workshop on containment integrity for nuclear power plants, Washington, DC (United States), 12-14 May 1992). In *Proceedings of the fifth workshop on containment integrity.* 646p. Source: OSTI; NTIS; INIS; GPO.

Considering the tremendous energy demand of a fast growing world population nuclear energy generation cannot be avoided. The safety of nuclear power plants can be increased by building strengthened containments, which will be able to withstand even severe core-melt accidents. Consequently, for a new containment design high static and dynamic internal overpressures must be taken into account. The design concept for next generation pressurized water reactors includes installation of a core catcher system and the removal of decay heat in a passive manner. Furthermore, several failure mechanisms of the reactor pressure vessel must be considered in the concept. Three design alternatives with different wall structures and cooling systems are demonstrated. The analysis of the long term thermo-hydraulic behavior and the determination of the loads resulting from hydrogen combustion are important factors for the containment design.

3413 (NUREG/CP–0120, pp. 367-380) **Overview of NUPEC containment integrity project.** Takumi, K. (Nuclear Power Engineering Corp., Tokyo (Japan)); Nonaka, A. Nuclear Regulatory Commission, Washington, DC (United States). Div. of Engineering; Sandia National Labs., Albuquerque, NM (United States). Jul 1992. (SAND–92-0173;CONF-920541–: 5. workshop on containment integrity for nuclear power plants, Washington, DC (United States), 12-14 May 1992). In *Proceedings of the fifth workshop on containment integrity.* 646p. Source: OSTI; NTIS; INIS; GPO.

Nuclear Power Engineering Corporation (NUPEC) started NUPEC Containment Integrity Project entitled Proving Test on the Reliability for Reactor Containment Vessel since June, 1987. The objective of this project is to confirm the integrity of containment vessels under accident conditions. In order to confirm the integrity of containment vessels, the proving tests are conducted. The test items are (1) hydrogen mixing and distribution test, (2) hydrogen burning test, (3) fission product behavior test, and (4) structural behavior test. Based on the test results, computer codes are verified and, as a result of analysis and evaluation by the computer codes, containment integrity is to be confirmed.

3414 (NUREG/CP–0120, pp. 381-385) **Plan on test to failure of a prestressed concrete containment vessel model.** Takumi, K. (Nuclear Power Engineering Corp., Tokyo (Japan)); Nonaka, A.; Umeki, K.; Nagata, K.; Soejima, M.; Yamaura, Y.; Costello, J.F.; Riesemann, W.A. von.; Parks, M.B.; Horschel, D.S. Nuclear Regulatory Commission, Washington, DC (United States). Div. of Engineering; Sandia National Labs., Albuquerque, NM (United States). Jul 1992. DOE Contract AC04-76DP00789. (SAND–92-0173;CONF-920541–: 5. workshop on containment integrity for nuclear power plants, Washington, DC (United States), 12-14 May 1992). In *Proceedings of the fifth workshop on containment integrity.* 646p. Source: OSTI; NTIS; INIS; GPO.

A summary of the plans to test a prestressed concrete containment vessel (PCCV) model to failure is provided in this paper. The test will be conducted as a part of a joint research program between the Nuclear Power Engineering Corporation (NUPEC), the United States Nuclear Regulatory Commission (NRC), and Sandia National Laboratories (SNL). The containment model will be a scaled representation of a PCCV for a pressurized water reactor (PWR). During the test, the model will be slowly pressurized internally until failure of the containment pressure boundary occurs. The objectives of the test are to measure the failure pressure, to observe the mode of failure, and to record the containment structural response up to failure. Pre- and posttest analyses will be conducted to forecast and evaluate the test results. Based on these results, a validated method for evaluating the structural behavior of an actual PWR PCCV will be developed. The concepts to design the PCCV model are also described in the paper.

3415 (NUREG/CP–0120, pp. 387-391) **Plan on test to failure of a steel containment vessel model.** Takumi, Kenji (Nuclear Power Engineering Corp., Tokyo (Japan)); Nonaka, Akira; Umeki, Katsuhiko; Yoshida, Yasushi; Oyamada, Osamu; Furukawa, Hideyasu; Saito, Koichi; Costello, J.F.; Riesemann, W.A. von; Parks, M.B.; Watson, R.A. Nuclear Regulatory Commission, Washington, DC (United States). Div. of Engineering; Sandia National Labs., Albuquerque, NM (United States). Jul 1992. DOE Contract AC04-76DP00789. (SAND–92-0173;CONF-920541–: 5. workshop on containment integrity for nuclear power plants, Washington, DC (United States), 12-14 May 1992). In *Proceedings of the fifth workshop on containment integrity.* 646p. Source: OSTI; NTIS; INIS; GPO.

This paper describes the plan for a test to failure of a steel containment vessel model. The test specimen proposed for this test is a scale model representing certain features of an improved boiling water reactor (BWR) MARK-II containment vessel. The objective of this test is to investigate the ultimate structural behavior of the model by incrementally increasing the internal pressure, at ambient temperature, until failure occurs. Pre- and posttest analyses will be

conducted to predict and evaluate the results of this test. The main objective of these analyses is to validate, by comparisons with the experimental data, the analytical methods used to evaluate the structural behavior of an actual containment vessel under severe accident conditions. This experiment is part of a cooperative program between the Nuclear Power Engineering Corporation, the United States Nuclear Regulatory Commission, and Sandia National Laboratories.

3416 (NUREG/CP–0120, pp. 393-406) **Concerning assessment of the strength and leaktightness of the double-shell containment of a 1,300 MWe PWR.** Dussarte, D. (IPSN/DES, Fontenay-aux-Roses (France)); Barbe, B.; Debec, E. Nuclear Regulatory Commission, Washington, DC (United States). Div. of Engineering; Sandia National Labs., Albuquerque, NM (United States). Jul 1992. (SAND–92-0173;CONF-920541–: 5. workshop on containment integrity for nuclear power plants, Washington, DC (United States), 12-14 May 1992). In *Proceedings of the fifth workshop on containment integrity.* 646p. Source: OSTI; NTIS; INIS; GPO.

The containment of a 1,300 MWe pressurized water reactor (PWR) consists of two concentric shells. The inner shell is of prestressed concrete while the outer shell is of reinforced concrete. Leakage from the inner shell is collected in the gap between the two shells which is maintained at a negative pressure by a pumping system. This study is concerned with two situations: (1) a slow rise in pressure resulting from the presence of a source of gas, the flow rate of which is considered to be a parameter, and (2) a sudden pressure rise which is taken to correspond to that which would be the result from a hydrogen deflagration. The numerical approach used in this study describes cracking of the inner shell under the effect of pressure and gives, at any given moment, the flow rate per unit mass entering the gap between the shells as well as the outflow from the containment until steady-state conditions are obtained.

3417 (NUREG/CP–0120, pp. 407-422) **Eccentric H_2 detonation in a nuclear power plant steel containment.** Maresca, G. (ENEA-DISP, Roma (Italy)); Pino, G. Nuclear Regulatory Commission, Washington, DC (United States). Div. of Engineering; Sandia National Labs., Albuquerque, NM (United States). Jul 1992. (SAND–92-0173;CONF-920541–: 5. workshop on containment integrity for nuclear power plants, Washington, DC (United States), 12-14 May 1992). In *Proceedings of the fifth workshop on containment integrity.* 646p. Source: OSTI; NTIS; INIS; GPO.

At present, studies are in progress at ENEA-DISP to assess the performance of a steel containment under hydrogen detonation. Although considered unprobable to occur, this event is studied as a load on the safe side challenging the containment. A complete model to simulate the shock wave behavior and the fluid-structure interaction between the containment atmosphere and the containment wall has been set up at ENEA-DISP and a monodimensional axisymmetric case already studied. In the present paper the two-dimensional extension of the numerical model has been used. A plane slice of the wall and of the atmosphere filling the containment is considered. A cylindrical detonation wave is supposed to start from a source located eccentrically with respect to the containment axis. Because of the exploratory nature of the numerical model, a period of only 20 msec has been considered, although 100 msec should be considered as a minimum in a large metal containment to exclude further growing of plastic strains produced by consecutive reflections. At variance with the axisymmetric case bending stresses are developed now. The use of the model in order to assess a strain failure criterion to be applied at the dynamic portion of the H_2 detonation load is considered. In the paper the influence of different initial values of the relevant parameters (pressure, temperature, hydrogen concentration and source location) is examined in order to assess a range of equivalent conditions.

3418 (NUREG/CP–0120, pp. 423-435) **Analysis of containment parameters during the main steam line break with the failure of the feedwater control valves.** Fabjan, L. (Jozef Stefan Inst., Ljubljana (Slovenia)); Petelin, S.; Mavko, B.; Gortnar, O.; Tiselj, I. Nuclear Regulatory Commission, Washington, DC (United States). Div. of Engineering; Sandia National Labs., Albuquerque, NM (United States). Jul 1992. (SAND–92-0173;CONF-920541–: 5. workshop on containment integrity for nuclear power plants, Washington, DC (United States), 12-14 May 1992). In *Proceedings of the fifth workshop on containment integrity.* 646p. Source: OSTI; NTIS; INIS; GPO.

U.S. Nuclear Regulatory Commission (NRC) information notice 91-69: 'Errors in Main Steam Line Break Analyses for Determining Containment Parameters' shows the possibility of an accident which could lead to beyond design containment pressure and temperature. Such accident would be caused by the continuation of feedwater flow following a main stream line break (MSLB) inside the containment. Krsko power plant already experienced problems with main feedwater control valves. For that reason, analysis of MSLB has been performed taking into account continuous feedwater addition scenario and different containment safety systems capabilities availability. Steam and water released into the containment during MSLB was calculated using RELAP5/MOD2 computer code. The containment response to MSLB was calculated using CONTEMPT-LT/028 computer code. The results indicated that the continuous feedwater flow following a MSLB could lead to beyond design containment pressure. The peak pressure and temperature depend on isolation time for main- and auxiliary-feedwater supply. In the case of low boron concentration injection, the core recriticality is characteristic for this type of accidents. It was concluded that the presented analysis of MSLB with continuous feedwater addition scenario is the worst case for containment design.

3419 (NUREG/CP–0120, pp. 439-455) **Small-scale penetration leak test in ALPHA program.** Yamano, Norihiro (Japan Atomic Energy Research Inst., Ibaraki-ken (Japan)); Sugimoto, Jun; Maruyama, Yu; Hidaka, Akihide; Soda, Kunihisa. Nuclear Regulatory Commission, Washington, DC (United States). Div. of Engineering; Sandia National Labs., Albuquerque, NM (United States). Jul 1992. (SAND–92-0173;CONF-920541–: 5. workshop on containment integrity for nuclear power plants, Washington, DC (United States), 12-14 May 1992). In *Proceedings of the fifth workshop on containment integrity.* 646p. Source: OSTI; NTIS; INIS; GPO.

Small scale penetration leak test has been performed as a part of ALPHA program at JAERI since 1990. Two series of experiments were performed in the test using test sections which simulate important parts of an electrical penetration assembly (EPA) in a Japanese pressurized water reactor. One of the test sections simulates an alumina module and the other includes silicone resin portion of the EPA. The test section was installed in a leak test vessel in which one region simulated inside of the containment and the other region simulated outside of the containment. Four experiments were performed using the alumina module test section. The test section was heated up to 720 K at maximum 1.8 MPa. No leakage was detected in the experiments. Two experiments were performed using the silicone resin test section at near atmospheric pressure. Initial leak path formation was detected at about 420 K. It was found that heat conduction along metal portion had strong influence on melt progression of the resin. It was also found from the strain measurement that the thermal loads were predominant over the pressure loads. From the results of the experiments, it is considered that the alumina module will keep integrity in severe accident conditions, although the silicone resin is estimated to melt at high temperature. Therefore, the EPA as a whole is estimated to maintain leak-tightness during the severe accident.

3420 (NUREG/CP–0120, pp. 457-463) **High-temperature leak characteristics test of PCV hatch flanges gasket.** Hirao, Katumi (Tokyo Electric Power Co. (Japan)); Goto, Masashi; Naruse, Yoshihiro; Saito, Kouichi; Suzuki, Takuro; Sugino, Hiroyuki. Nuclear Regulatory Commission, Washington, DC (United States). Div. of Engineering; Sandia National Labs., Albuquerque, NM (United States). Jul 1992. (SAND–92-0173;CONF-920541–: 5. workshop on containment integrity for nuclear power plants, Washington, DC (United States), 12-14 May 1992). In *Proceedings of the fifth workshop on containment integrity.* 646p. Source: OSTI; NTIS; INIS; GPO.

This paper describes the leak characteristics of the sealing materials being used at primary containment vessel (PCV) hatch flanges at boiling water reactor plants in Japan at temperatures exceeding the design conditions in anticipation of severe accidents. It was

found that there was no noticeable leakage regardless of the bolt tightness at temperatures at 250 C and below, but the mechanical characteristics of the silicon rubber were lost and the sealability was impaired at temperatures of approx. 275 C ~ 300 C.

3421 (NUREG/CP–0120, pp. 465-495) **An investigation of liner tearing in reinforced concrete reactor containment buildings: Comparison of experimental and analytical results.** Spletzer, B.L. (Sandia National Lab., Albuquerque, NM (United States)); Lambert, L.D.; Weatherby, J.R. Nuclear Regulatory Commission, Washington, DC (United States). Div. of Engineering; Sandia National Labs., Albuquerque, NM (United States). Jul 1992. DOE Contract AC04-76DP00789. (SAND–92-0173;CONF-920541–: 5. workshop on containment integrity for nuclear power plants, Washington, DC (United States), 12-14 May 1992). In *Proceedings of the fifth workshop on containment integrity.* 646p. Source: OSTI; NTIS; INIS; GPO.

The overpressurization of a 1:6 scale reinforced concrete containment building demonstrated that liner tearing is a plausible failure mode in such structures under severe accident conditions. A combined experimental and analytical program was developed to determine the important parameters that affect liner tearing and to develop reasonably simple analytical methods for predicting when tearing will occur. Three sets of test specimens were designed to allow individual control over and investigation of the mechanisms believed to be important in causing failure of the liner plate. The series of tests investigated the effect on linear tearing produced by the anchorage system, the loading conditions, and the transition in thickness of the liner. Before testing, the specimens were analyzed using two- and three-dimensional finite element models. Based on the analysis, the failure mode and corresponding load conditions were predicted for each specimen. Test data and posttest examination of test specimens shows mixed agreement with the analytical predictions with regard to failure mode and specimen response for most tests. Many similarities were also observed between the response of the liner in the 1:6 scale reinforced concrete containment model and the response of the test specimens. This work illustrates the fact that the failure mechanism of a reinforced concrete containment building can be greatly influenced by details of liner and anchorage system design. Furthermore, it significantly increases the understanding of containment building response under severe accident conditions.

3422 (NUREG/CP–0120, pp. 497-514) **Numerical simulation of the ultimate load capacity of a reactor containment building.** Andreoli, V. (ISMES, Bergamo (Italy)); Angeloni, P.; Contri, P.; Brusa, L. Nuclear Regulatory Commission, Washington, DC (United States). Div. of Engineering; Sandia National Labs., Albuquerque, NM (United States). Jul 1992. (SAND–92-0173;CONF-920541–: 5. workshop on containment integrity for nuclear power plants, Washington, DC (United States), 12-14 May 1992). In *Proceedings of the fifth workshop on containment integrity.* 646p. Source: OSTI; NTIS; INIS; GPO.

From the 1980's onwards specific requirements of standard guidelines related to failure analysis have made necessary an extensive application of nonlinear numerical models for light water reactor containment safety assessment. On the same period new structure types have been proposed which reveal high sensitivities to loadcases reproducing accident conditions. The paper present the results of preliminary nonlinear calculations on simplified models. The results point out how using different load incrementing schemes significantly different failure mechanisms and limit load factors can be calculated. This fact stresses the need for seeking for a general agreement on simulation criteria to be used in safety evaluations in order to obtain fully understandable and comparable results.

3423 (NUREG/CP–0120, pp. 515-550) **Research and development performed at CEA/DMT in the field of nuclear reactors containments.** Millard, A.; Jamet, P.; Barbe, B.; Lecomte, C. Nuclear Regulatory Commission, Washington, DC (United States). Div. of Engineering; Sandia National Labs., Albuquerque, NM (United States). Jul 1992. (SAND–92-0173;CONF-920541–: 5. workshop on containment integrity for nuclear power plants, Washington, DC (United States), 12-14 May 1992). In *Proceedings of the fifth workshop on containment integrity.* 646p. Source: OSTI; NTIS; INIS; GPO.

The behavior of containment is a key issue with respect to the safety of nuclear power plants. Extensive work has been performed for many years at CEA/DMT (Department of Mechanics and Technology) on this subject particularly on the behavior of containment under severe accidents. Large research and development programs have been carried out and are still under progress to handle the following problems: thermo-mechanical response on the containment under increasing pressure and temperature up to the ultimate behavior of the structure; behavior of the containment in case of hydrogen detonation or steam explosion; modelization and evaluation of containment leaking after a severe accident inducing cracks in the structure; and response of the containment to seismic loads. These studies have been carried out by means of finite element computations. The computer codes have been developed and validated using either analytical solutions or experimental results. Specific developments have been made in order to be able to solve the above mentioned problems: material models for reinforced concrete; fast dynamic algorithms for impacts; seismic analysis techniques and soil-structure interactions; and gas dynamics, shock waves and fluid-structure interaction. More recently, new programs have also been undertaken, concerning the behavior of containment after core melt and vessel break through. Work is in progress at CEA/DMT in the two following areas: conceptual studies concerning core catcher and residual power evacuation and design method development of core catcher, including numerical code development.

3424 (NUREG/CP–0120, pp. 551-563) **Creep rupture failure in a Mark I containment with a new thermal failure material model.** Castro, J.C. (ANATECH Research Corp., San Diego, CA (United States)); Dameron, R.A.; Rashid, J.R. Nuclear Regulatory Commission, Washington, DC (United States). Div. of Engineering; Sandia National Labs., Albuquerque, NM (United States). Jul 1992. (SAND–92-0173;CONF-920541–: 5. workshop on containment integrity for nuclear power plants, Washington, DC (United States), 12-14 May 1992). In *Proceedings of the fifth workshop on containment integrity.* 646p. Source: OSTI; NTIS; INIS; GPO.

Recent failure probability studies of Mark I containments use the steel melting temperature as the failure criterion. However the possibility of creep rupture could lead to failure at lower temperatures. The present analysis uses a thermo-mechanical failure criterion that takes creep rupture into account. The analysis considers the local interaction of the shell with the surrounding concrete floor and shield building. Applied temperature and pressure boundary conditions for the liner are determined from previous studies by the University of California at Santa Barbara. The analysis focuses on the potential failure of the containment shell near the shell-concrete base juncture when the shell is subject to contact with corium during a severe accident. Material data for the response analysis and failure evaluation were obtained from Idaho National Engineering Laboratory and Electric Power Research Institute. A rate-dependent viscoplastic constitutive model was developed which uses data for both the response analysis and creep rupture evaluation. The model is capable of tracking the material response throughout its history from the low temperature, purely elastic regime to the very high temperature, low strength, large strain rate regime. The two dimensional results indicate that creep rupture could occur at temperatures close to 1,100 C. A more realistic three dimensional analysis could result in higher creep rupture temperatures depending on the size and distribution of the shell-corium contact surface. This analysis, however, has not yet been completed.

3425 (NUREG/CP–0120, pp. 567-572) **Containment leakage rate testing requirements.** Arndt, E.G. (U. S. Regulatory Commission, Washington, DC (United States)). Nuclear Regulatory Commission, Washington, DC (United States). Div. of Engineering; Sandia National Labs., Albuquerque, NM (United States). Jul 1992. (SAND–92-0173;CONF-920541–: 5. workshop on containment integrity for nuclear power plants, Washington, DC (United States), 12-14 May 1992). In *Proceedings of the fifth workshop on containment integrity.* 646p. Source: OSTI; NTIS; INIS; GPO.

This report presents the status of several documents under revision or development that provide requirements and guidance for

testing nuclear power plant containment systems for leakage rates. These documents include the general revision to 10 CFR Part 50, Appendix J; the regulatory guide affiliated with the revision to Appendix J; the national standard that the regulatory guide endorses, ANSI/ANS-56.8, 'Containment System Leakage Rate Testing Requirements'; and the draft industry Licensing Topical Report, 'Standardized Program for Primary Containment Integrity Testing'. The actual or potential relationships between these documents are also explored.

3426 (NUREG/CP–0120, pp. 573-577) **ANSI/ANS 56.8 standard committee status report.** Glover, J.P. (Commonwealth Edison Co., Downers Grove, IL (United States)). Nuclear Regulatory Commission, Washington, DC (United States). Div. of Engineering; Sandia National Labs., Albuquerque, NM (United States). Jul 1992. (SAND–92-0173;CONF-920541–: 5. workshop on containment integrity for nuclear power plants, Washington, DC (United States), 12-14 May 1992). In *Proceedings of the fifth workshop on containment integrity.* 646p. Source: OSTI; NTIS; INIS; GPO.

This report discusses the major changes being made to the 1987 version of ANSI/ANS-5.68, 'Containment System Leakage Rate Testing Requirements'. A brief history and current status of a related document NEDO-31722, 'Standardization Program for Primary Containment Integrity Testing' is also presented. The possible relationship between these two documents and the draft revision of 10 CFR 50 Appendix J are outlined.

3427 (NUREG/CP–0120, pp. 579-582) **Industry current and future plans for implementation of proposed revision of 10 CFR Part 50, Appendix J, Containment Leak Rate Testing.** Nuclear Regulatory Commission, Washington, DC (United States). Div. of Engineering; Sandia National Labs., Albuquerque, NM (United States). Jul 1992. (SAND–92-0173;CONF-920541–: 5. workshop on containment integrity for nuclear power plants, Washington, DC (United States), 12-14 May 1992). In *Proceedings of the fifth workshop on containment integrity.* 646p. Source: OSTI; NTIS; INIS; GPO.

The Nuclear Regulatory Commission (NRC) has proposed revision of the Containment leak rate testing requirements as specified in 10 CRF Part 50, Appendix J, Leakage Rate Testing of Containments of Light-Water Cooled Nuclear Power Plants, as described in documents released to the NRC Public Document Room on January 10, 1992. It is the authors understanding that this proposed revision of Appendix J reflects the staff disposition of public comments that is in process of review by the Commissioners. The industry has maintained a continuing dialogue with the NRC through public forums such as interactions of the boiling water reactor nuclear steam supply systems Owners Group, the ANS 56.8 Committee, Containment Leak Rate Test Work Shops and, since 1991, as a generic issue through Nuclear Management and Resources Council/NRC meetings. This dialogue has positively contributed to a communication and understanding of methods and issues that can facilitate containment leak rate testing. The industry's review of the proposed Appendix J revision indicates that resolution of certain aspects of the revision could further reduce contamination, exposure and unnecessary use of resources without any reduction in the health and safety of the public.

3428 (NUREG/CP–0120, pp. 583-594) **Containment penetrations - flexible metallic bellows testing, safety, life extension issues.** Brown, J.A. (NUTECH Engineers, Westmont, IL (United States)); Tice, G.A. Nuclear Regulatory Commission, Washington, DC (United States). Div. of Engineering; Sandia National Labs., Albuquerque, NM (United States). Jul 1992. (SAND–92-0173;CONF-920541–: 5. workshop on containment integrity for nuclear power plants, Washington, DC (United States), 12-14 May 1992). In *Proceedings of the fifth workshop on containment integrity.* 646p. Source: OSTI; NTIS; INIS; GPO.

The performance and long-term operational integrity of containment systems and components is being challenged as many of the world's nuclear plants progress into the second half of their design lives. As time in service increases, so does the likelihood of component degradation and failure. By observing trends in containment degradation, potential weaknesses can be anticipated and corrected, minimizing interruptions in operations, increasing safety and improving the plant's life extension outlook. One such trend, affecting containment penetration flexible metallic bellows that are subject to cyclic loading, is beginning to appear in some boiling water reactor plants. Although the overall performance of flexible metallic bellows penetrations has appeared to be acceptable for approximately 20 years, aging and degradation of these components has been recently identified. This paper presents a description of efforts made to characterize the nature and significance of the penetration degradation observed. Field pressure testing and laboratory examinations are discussed, as well as evaluations to determine leak areas and leakage rates. Crack growth from both corrosion and fatigue mechanisms are examined, and methods for predicting remaining useful life are discussed. The repair and replacement methods employed will be summarized as well as the testing performed to demonstrate replacement effectiveness.

3429 (NUREG/CP–0120, pp. 595-623) **Aging of concrete containment structures in nuclear power plants.** Naus, D.J. (Oak Ridge National Lab., TN (United States)); Oland, C.B.; Ellingwood, B.; Mori, Yasuhiro; Arndt, E.G. Nuclear Regulatory Commission, Washington, DC (United States). Div. of Engineering; Sandia National Labs., Albuquerque, NM (United States). Jul 1992. DOE Contract AC05-84OR21400. (SAND–92-0173;CONF-920541–: 5. workshop on containment integrity for nuclear power plants, Washington, DC (United States), 12-14 May 1992). In *Proceedings of the fifth workshop on containment integrity.* 646p. Source: OSTI; NTIS; INIS; GPO.

Concrete structure play a vital role in the safe operation of all light-water reactor plants in the U.S. Pertinent concrete structures are described in terms of their importance, design considerations, and materials of construction. Degradation factors which can potentially impact the ability of these structure to meet their functional and performance requirements are identified. Current inservice inspection requirements for concrete containments are summarized. A review of the performance history of the concrete components in nuclear power plants is provided. A summary is presented of the Structural Aging (SAG) Program being conducted at the Oak Ridge National Laboratory for the U.S. Nuclear Regulatory Commission. The SAG Program is addressing the aging management of safety-related concrete structures in nuclear power plants for the purpose of providing improved bases for their continued service. The program consists of a management task and three technical tasks: materials property data base, structural component assessment/repair technologies, and quantitative methodology for continued service conditions. Objectives and a summary of accomplishments under each of these tasks are presented.

3430 (NUREG/CP–0120, pp. 625-649) **Updated ASME code rules for inservice inspection of steel and concrete containments.** Sammataro, R.F. (General Dynamics Corp., Groton, CT (United States)). Nuclear Regulatory Commission, Washington, DC (United States). Div. of Engineering; Sandia National Labs., Albuquerque, NM (United States). Jul 1992. (SAND–92-0173;CONF-920541–: 5. workshop on containment integrity for nuclear power plants, Washington, DC (United States), 12-14 May 1992). In *Proceedings of the fifth workshop on containment integrity.* 646p. Source: OSTI; NTIS; INIS; GPO.

Rules for the inservice inspection of nuclear power plant components are contained in Section XI of the American Society of Mechanical Engineers Boiler and Pressure Vessel Code. These rules form a basis for the preservice examination, inservice inspection, modification, repair, replacement, and leakage testing for steel and concrete containments. The rules for steel containments in subsection IWE, including metallic liners for concrete containments, were first published in 1981. These inservice inspection requirements were based upon visual examination of the containment welds. The rules for concrete containments in Subsection IWL were first published in 1988. These rules apply to concrete surfaces and to post-tensioning systems for posttensioned containments. Experience has shown that steel containments and metallic liners of concrete containments are not susceptible to failure of the containment pressure boundary welds. Rather, base metal degradation through corrosion and other mechanisms has been found to be a significant and potentially limiting condition for acceptability of

containments for continued service. A program was therefore initiated in 1989 to revise the ASME Code containment inservice inspection rules for steel containments to replace the requirements for weld-based inspections with requirements for containment surface examinations. These revised rules were published in December 1991. This paper describes the updated rules for inservice inspection of steel and concrete containments in Subsection IWE and Subsection IWL of Section XI. A history of the development of these rules and the experience base that fostered a change in the containment inspection philosophy is presented.

3431 (NUREG/CP–0120, pp. 651-661) **A review on operating experiences of containment isolation systems in Korea.** Kim, I. (Korea Institute of Nuclear Safety, Taejon (Korea)); Kim, H.J. Nuclear Regulatory Commission, Washington, DC (United States). Div. of Engineering; Sandia National Labs., Albuquerque, NM (United States). Jul 1992. (SAND–92-0173;CONF-920541–: 5. workshop on containment integrity for nuclear power plants, Washington, DC (United States), 12-14 May 1992). In *Proceedings of the fifth workshop on containment integrity.* 646p. Source: OSTI; NTIS; INIS; GPO.

Wide experiences in operating containment isolation systems have been accumulated in Korea since 1978. Hence, it becomes necessary to review the operating data in order to confirm the integrity of containments with about 50 reactor-years of experience and to establish the future direction to the containment test program. The objectives of the present work are to collect, consolidate and assess the operational data relevant to containment isolation systems, and then to find out types of isolation valve failures, dominant leakage paths and factors affecting integrated leakage rate test. Leakage is observed to be the most frequent type of isolation valve failure. The causes of the leakage are packing leakage, seat damage due to foreign material, and mis-adjustment of torque switches. The malfunction and deterioration are also observed to be a frequent failure mode. General trends of overall leakage show that more careful surveillance during pre-operational test can reduce the containment leakage. Dominant leakage paths are found to be through air locks and large-sized valves, such as butterfly valves of purge lines, so that weighted surveillance and inspection on these dominant leakage paths can considerably reduce the containment leakage. The atmosphere stabilization are found to be the most important to obtain the reliable result. In order to get well stabilized atmosphere, temperature and flow rate of compressed air should be kept constant and it is preferable not to operate fan cooler during pressurizing the containment for test.

3432 (NUREG/CR–4674-Vol.16) **Precursors to potential severe core damage accidents: 1991, A status report: Volume 16, Appendices B, C, and D.** Minarick, J.W. (Science Applications International Corp., Oak Ridge, TN (United States)); Dolan, B.W.; Cletcher, J.W.; Copinger, D.A. Nuclear Regulatory Commission, Washington, DC (United States). Div. of Safety Programs; Oak Ridge National Lab., TN (United States). Sep 1992. 719p. Sponsored by Nuclear Regulatory Commission, Washington, DC (United States). DOE Contract AC05-84OR21400. (ORNL/NOAC–232-Vol.16). Source: OSTI; NTIS; INIS; GPO.

Twenty-eight operational events with conditional probabilities of core damage of 1.0×10^{-6} or higher occurring at commercial light-water reactors during 1991 are considered to be precursors to potential severe core damage. These are described along with associated significance estimates, categorization, and subsequent analyses. This study is a continuation of earlier work, which evaluated the 1969–1981 and 1984–1990 events. The report discusses (1) the general rationale for this study, (2) the selection and documentation of events as precursors, (3) the estimation and use of conditional probabilities of subsequent severe core damage to rank precursor events, and (4) the plant models used in the analysis process. This document contains appendices B, C, and D of this report. These appendices are titled respectively; precursors; containment-related and other event documentation; and potentially significant events that were impractical to analyze.

3433 (NUREG/CR–5305-Vol.3) **Integrated Risk Assessment for the LaSalle Unit 2 Nuclear Power Plant, Phenomenology and Risk Uncertainty Evaluation Program (PRUEP), MELCOR code calculations: Volume 3.** Shaffer, C.J. (Science and Engineering Associates, Albuquerque, NM (United States)); Miller, L.A.; Payne, A.C. Jr. Nuclear Regulatory Commission, Washington, DC (United States). Div. of Safety Issue Resolution; Sandia National Labs., Albuquerque, NM (United States). Oct 1992. 571p. Sponsored by Nuclear Regulatory Commission, Washington, DC (United States). DOE Contract AC04-76DP00789. (SAND–90-2765-Vol.3). Source: OSTI; NTIS; INIS; GPO.

A Level III Probabilistic Risk Assessment (PRA) has been performed for LaSalle Unit 2 under the Risk Methods Integration and Evaluation Program (RMIEP) and the Phenomenology and Risk Uncertainty Evaluation Program (PRUEP). This report documents the phenomenological calculations and sources of. uncertainty in the calculations performed with HELCOR in support of the Level II portion of the PRA. These calculations are an integral part of the Level II analysis since they provide quantitative input to the Accident Progression Event Tree (APET) and Source Term Model (LASSOR). However, the uncertainty associated with the code results must be considered in the use of the results. The MELCOR calculations performed include four integrated calculations: (1) a high-pressure short-term station blackout, (2) a low-pressure short-term station blackout, (3) an intermediate-term station blackout, and (4) a long-term station blackout. Several sensitivity studies investigating the effect of variations in containment failure size and location, as well as hydrogen ignition concentration are also documented.

3434 (NUREG/CR–5443) **Core-concrete interactions using molten urania with zirconium on a limestone concrete basemat: The SURC-1 experiment.** Copus, E.R. (Sandia National Labs., Albuquerque, NM (United States)); Brockmann, J.E.; Simpson, R.B.; Lucero, D.A.; Blose, R.E. Nuclear Regulatory Commission, Washington, DC (United States). Div. of Systems Research; Sandia National Labs., Albuquerque, NM (United States). Sep 1992. 275p. Sponsored by Nuclear Regulatory Commission, Washington, DC (United States). DOE Contract AC04-76DP00789. (SAND–90-0087). Source: OSTI; NTIS; INIS; GPO.

An inductively heated experiment SURC-1, using UO_2-ZrO_2 material, was executed to measure and assess the thermal, gas, and aerosol source terms produced during core debris/concrete interactions. The SURC-1 experiment eroded a total of 27 cm of limestone concrete during 130 minutes of sustained interaction using 204.2 kg of molten prototypic UO_2-ZrO_2 core debris material that included 18 kg of zr metal and 3.4 kg of fission product simulants. The melt pool temperature ranged from 2100 to 2400°C during the first 50 minutes of the test, followed by steady temperatures of 2000 to 2100°C during the middle portion of the test and temperatures of 1800 to 2000°C during the final 50 minutes of testing. The total erosion during the first 50 minutes was 16 cm with an additional 2 cm during the middle part of the test and 9 cm of ablation during the final 50 minutes. Aerosols were continuously released in concentrations ranging from 30 to 200 g/m^3. Comprehensive gas flow rates, gas compositions, and aerosol compositions were also measured during the SURC-1 test.

3435 (NUREG/CR–5826) **Auxiliary feedwater system risk-based inspection guide for the Maine Yankee Nuclear Power Plant.** Gore, B.F. (Pacific Northwest Lab., Richland, WA (United States)); Vo, T.V.; Moffitt, N.E.; Bumgardner, J.D. Nuclear Regulatory Commission, Washington, DC (United States). Div. of Radiation Protection and Emergency Preparedness; Pacific Northwest Lab., Richland, WA (United States). Oct 1992. 29p. Sponsored by Nuclear Regulatory Commission, Washington, DC (United States). DOE Contract AC06-76RL01830. (PNL–7654). Source: OSTI; NTIS; INIS; GPO.

In a study sponsored by the US Nuclear Regulatory Commission (NRC), Pacific Northwest Laboratory has developed and applied a methodology for deriving plant-specific risk-based inspection guidance for the auxiliary feedwater (AFW) system at pressurized water reactors that have not undergone probabilistic risk assessment (PRA). This methodology uses existing PRA results and plant operating experience information. Existing PRA-based inspection guidance information recently developed for the NRC for various plants was used to identify generic component failure modes. The information was then combined with plant-specific and industry-wide component information and failure data to identify failure

modes and failure mechanisms for the AFW system at the selected plants. Maine Yankee was selected as one of a series of plants for study. ne product of this effort is a prioritized listing of AFW failures which have occurred at the plant and at other PWRs. This listing is intended for use by NRC inspectors in the preparation of inspection plans addressing AFW risk-important components at the Maine Yankee plant.

3436 (NUREG/CR–5837) **Auxiliary feedwater system risk-based inspection guide for the North Anna nuclear power plants.** Nickolaus, J.R. (Pacific Northwest Lab., Richland, WA (United States)); Moffitt, N.E.; Gore, B.F.; Vo, T.V. Nuclear Regulatory Commission, Washington, DC (United States). Div. of Radiation Protection and Emergency Preparedness; Pacific Northwest Lab., Richland, WA (United States). Oct 1992. 29p. Sponsored by Nuclear Regulatory Commission, Washington, DC (United States). DOE Contract AC06-76RL01830. (PNL–7923). Source: OSTI; NTIS; INIS; GPO.

In a study sponsored by the US Nuclear regulatory Commission (NRC), Pacific Northwest Laboratory has developed and applied a methodology for deriving plant-specific risk-based inspection guidance for the auxiliary feedwater (AFW) system at pressurized water reactors that have not undergone probabilistic risk assessment (PRA). This methodology uses existing PRA results and plant operating experience information. Existing PRA-based inspection guidance information recently developed for the NRC for various plants was used to identify generic component failure modes. This information was then combined with plant-specific and industry-wide component information and failure data to identify failure modes and failure mechanisms for the AFW system at the selected plants. North Anna was selected as a plant for study. The product of this effort is a prioritized listing of AFW failures which have occurred at the plant and at other PWRs. This listing is intended for use by the NRC inspectors in preparation of inspection plans addressing AFW risk important components at the North Anna plant.

3437 (NUREG/CR–5912) **Review of the technical basis and verification of current analysis methods used to predict seismic response of spent fuel storage racks.** DeGrassi, G. (Brookhaven National Lab., Upton, NY (United States)). Nuclear Regulatory Commission, Washington, DC (United States). Div. of Engineering; Brookhaven National Lab., Upton, NY (United States). Oct 1992. 23p. Sponsored by Nuclear Regulatory Commission, Washington, DC (United States). DOE Contract AC02-76CH00016. (BNL-NUREG–52335). Source: OSTI; NTIS; INIS; GPO.

This report presents the results of a literature review on spent fuel rack seismic analysis methods and modeling procedures. The analysis of the current generation of free standing high density spent fuel racks requires careful consideration of complex phenomena such as rigid body sliding and tilting motions; impacts between adjacent racks, between fuel assemblies and racks, and between racks and pool walls and floor; fluid coupling and frictional effects. The complexity of the potential seismic response of these systems raises questions regarding the levels of uncertainty and ranges of validity of the analytical results. BNL has undertaken a program to investigate and assess the strengths and weaknesses of current fuel rack seismic analysis methods. The first phase of this program involved a review of technical literature to identify the extent of experimental and analytical verification of the analysis methods and assumptions. Numerous papers describing analysis methods for free standing fuel racks were reviewed. However, the extent of experimental verification of these methods was found to be limited. Based on the information obtained from the literature review, the report provides an assessment of the significance of the issues of concern and makes recommendations for additional studies.

3438 (NUREG/CR–5925-Vol.2) **Risk-based technical specifications: Development and application of an approach to the generation of a plant specific real-time risk model: Appendices, Volume 2.** Puglia, B. (Science Applications International Corp., Reston, VA (United States)); Gallagher, D.; Amico, P.; Atefi, B. Nuclear Regulatory Commission, Washington, DC (United States). Div. of Operational Events Assessment; Science Applications International Corp., Reston, VA (United States). Oct 1992. 675p. Sponsored by Nuclear Regulatory Commission, Washington, DC (United States). (SAIC–92/6668-R1-Vol.2). Source: OSTI; NTIS; INIS; GPO.

This report describes a process developed to convert an existing PRA into a model amenable to real time, risk-based technical specification calculations. In earlier studies (culminating in NUREG/CR-5742), several risk-based approaches to technical specification were evaluated. A real-time approach using a plant specific PRA capable of modeling plant configurations as they change was identified as the most comprehensive approach to control plant risk. A master fault tree logic model representative of-all of the core damage sequences was developed. Portions of the system fault trees were modularized and supercomponents comprised of component failures with similar effects were developed to reduce the size of the model and, quantification times. Modifications to the master fault tree logic were made to properly model the effect of maintenance and recovery actions. Fault trees representing several actuation systems not modeled in detail in the existing PRA were added to the master fault tree logic. This process was applied to the Surry NUREG-1150 Level 1 PRA. The master logic mode was confirmed. The model was then used to evaluate frequency associated with several plant configurations using the IRRAS code. For all cases analyzed computational time was less than three minutes. This document Volume 2, contains appendices A, B, and C. These provide, respectively: Surry Technical Specifications Model Database, Surry Technical Specifications Model, and a list of supercomponents used in the Surry Technical Specifications Model.

3439 (NUREG/IA–0089) **Post-test-analysis and nodalization studies of OECD LOFT experiment LP-LB-1 with RELAP5/Mod2 cy36-02.** Luebbesmeyer, D. (Paul Scherrer Inst. (PSI), Villigen (Switzerland)). Nuclear Regulatory Commission, Washington, DC (United States). Office of Nuclear Regulatory Research; Paul Scherrer Inst. (PSI), Villigen (Switzerland). Oct 1992. 178p. Sponsored by Nuclear Regulatory Commission, Washington, DC (United States). (PSI–Bericht-Nr.91). Source: OSTI; NTIS; INIS; GPO.

This report presents the insults and analysis of ten post-test calculations of the experiment LP-LB-1 by using the RELAP5/MOD2 CY36-02 computer code with different nodalizations. Starting with the "standard nodalization" we have reduced the number of volumes and junctions as well as the number of radial zones in the fuel rods. Only small discrepancies have been observed between the results of calculations using different nodalizations. Reduced numbers of volumes and junctions usually have decreased the running time of the problem. The time behaviors of cladding temperatures have been significantly affected by the chosen nodalizations but surprisingly, the results for the cases with a reduced number of volumes and junctions seem to be slightly closer to the experimental data. With respect to top-down rewetting, one of the key-events of Experiment LP-LB-1 during the blow-down phase, RELAP5/MOD2 was not at all able to predict this phenomenon.

3440 (ORNL/TM–7448) **Evaluation of the Submerged Demineralizer System (SDS) flowsheet for decontamination of high-activity-level water at the Three Mile Island Unit 2 Nuclear Power Station.** Campbell, D.O., Collins, E.D., King, L.J., Knauer, J.B. Oak Ridge National Lab., TN (United States). Jul 1980. 87p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. Order Number DE93003070. Source: OSTI; NTIS; GPO Dep.

This report discusses the Submerged Demineralizer System (SDS) flowsheet for decontamination of the high-activity-level water at the Three Mile Island Unit 2 Nuclear Power Station was evaluated at Oak Ridge National Laboratory in a study that included filtration tests, ion exchange column tests, and ion exchange distribution tests. The contaminated waters, the SDS flowsheet, and the experiments made are described. The experimental results were used to predict the SDS performance and to indicate potential improvements.

3441 (ORNL/TM–12230) **Specifications for the development of BUGLE-93: An ENDF/B-VI multigroup cross section library for LWR shielding and pressure vessel dosimetry.** White, J.E.; Wright, R.Q.; Roussin, R.W.; Ingersoll, D.T. Oak Ridge National Lab., TN (United States). Nov 1992. 31p. Sponsored by Nuclear Regulatory Commission, Washington, DC (United States).

DOE Contract AC05-84OR21400. Order Number DE93004028. Source: OSTI; NTIS; INIS; GPO Dep.

This report discusses specifications which have been developed for a new multigroup cross section library based on ENDF/B-VI data for light water reactor shielding and reactor pressure vessel dosimetry applications. The resulting broad-group library and an intermediate fine-group library are defined by the specifications provided in this report. Processing ENDF/B-VI into multigroup format for use in radiation transport codes will provide radiation shielding analysts with the most currently available nuclear data. it is expected that the general nature of the specifications will be useful in other applications such as reactor physics.

3442 (RISLEY-Trans–5923) **Nuclear power stations in August: information and commentary.** Rogozhin, Yu. UKAEA Risley Nuclear Power Development Labs. (United Kingdom). [1989]. 3p. Translated from Izvestiya, 6 September 1989. Order Number DE93000501. Source: OSTI; NTIS (US Sales Only).

This document is a translation discussing nine unplanned shutdowns and thirteen unsanctioned power reductions of USSR reactors during August 1989.

3443 (SAND–92-0978C) **Risk evaluation of accident management strategies.** Dingman, S.; Camp, A. Sandia National Labs., Albuquerque, NM (United States). [1992]. 7p. Sponsored by Nuclear Regulatory Commission, Washington, DC (United States). DOE Contract AC04-76DP00789. (CONF-930116–6: Probabilistic safety assessment international topical meeting, Clearwater Beach, FL (United States), 27-29 Jan 1993). Order Number DE93002463. Source: OSTI; NTIS; INIS; GPO Dep.

The use of Probabilistic Risk Assessment (PRA) methods to evaluate accident management strategies in nuclear power plants discussed in this paper. The PRA framework allows an integrated evaluation to be performed to give the full implications of a particular strategy. The methodology is demonstrated for a particular accident management strategy, intentional depressurization of the reactor coolant system to avoid containment pressurization during the ejection of molten debris at vessel breach.

3444 (SAND–92-1261C) **Abridged risk analysis of a selected regime of shutdown for the Grand Gulf nuclear power plant.** Brown, T.D.; Miller, L.A. Sandia National Labs., Albuquerque, NM (United States). [1992]. 8p. Sponsored by Nuclear Regulatory Commission, Washington, DC (United States). DOE Contract AC04-76DP00789. (CONF-930116–5: Probabilistic safety assessment international topical meeting, Clearwater Beach, FL (United States), 27-29 Jan 1993). Order Number DE93002464. Source: OSTI; NTIS; INIS; GPO Dep.

An abridged Level II probabilistic risk assessment was performed on a selected portion of the refueling mode of operation at the Grand Gulf nuclear power plant. In this abridged analysis simplified PRA models were used to delineate the possible accident progressions, to estimate the source term and to assess the onsite consequences. The MACCS code was used to estimate the offsite consequences. While the decay heat is lower in shutdown accidents relative to full power accidents and, thus, there is potentially more time to respond to the accident, the plant is in a configuration that offers very little attenuation of a release should one occur. Thus, the reduction in the radionuclide potential from decay is counterbalanced by the lack of plant mitigation features. Offsite consequences associated with these shutdown accidents were shown to be comparable with full power accidents.

3445 (WSRC-MS–92-200) **Review of the Savannah River Site K-Reactor draft technical specifications.** Fields, C.C.; Hightower, N.T. III. Westinghouse Savannah River Co., Aiken, SC (United States). [1992]. 7p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC09-89SR18035. (CONF-921102–28: Joint American Nuclear Society (ANS)/European Nuclear Society (ENS) international meeting on fifty years of controlled nuclear chain reaction: past, present, and future, Chicago, IL (United States), 15-20 Nov 1992). Order Number DE93002155. Source: OSTI; NTIS; GPO Dep.

This report discusses a new review method which has been developed to ensure Savannah River Site (SRS) K Reactor Technical Specifications are consistent with the safety analyses. This method employs pre-printed forms to (1) ensure that reviews performed by several individuals were complete and consistent and (2) make the review process self-documenting.

3446 (WSRC-MS–92-227) **Core melt progression and consequence analysis methodology development in support of the Savannah River Reactor PSA.** O'Kula, K.R. (Westinghouse Savannah River Co., Aiken, SC (United States)); Sharp, D.A.; Amos, C.N.; Wagner, K.C.; Bradley, D.R. Westinghouse Savannah River Co., Aiken, SC (United States). [1992]. 5p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC09-89SR18035. (CONF-930116–1: Probabilistic safety assessment international topical meeting, Clearwater Beach, FL (United States), 27-29 Jan 1993). Order Number DE92016889. Source: OSTI; NTIS; INIS; GPO Dep.

A three-level Probabilistic Safety Assessment (PSA) of production reactor operation has been underway since 1985 at the US Department of Energy's Savannah River Site (SRS). The goals of this analysis are to: Analyze existing margins of safety provided by the heavy-water reactor (HWR) design challenged by postulated severe accidents; Compare measures of risk to the general public and onsite workers to guideline values, as well as to those posed by commercial reactor operation; and Develop the methodology and database necessary to prioritize improvements to engineering safety systems and components, operator training, and engineering projects that contribute significantly to improving plant safety. PSA technical staff from the Westinghouse Savannah River Company (WSRC) and Science Applications International Corporation (SAIC) have performed the assessment despite two obstacles: A variable baseline plant configuration and power level; and a lack of technically applicable code methodology to model the SRS reactor conditions. This paper discusses the detailed effort necessary to modify the requisite codes before accident analysis insights for the risk assessment were obtained.

24 POWER TRANSMISSION AND DISTRIBUTION

2401 Power Systems

Refer also to citation(s) 3505

3447 (ETDE-IT–92-83) **SELF: Expert system application to power system planning.** Pessi, E.; Gallanti, M.; Cicoria, R. Ente Nazionale per l'Energia Elettrica, Milan (Italy). Centro di Ricerca Elettrica; Centro Informazioni Studi Esperienze (CISE), Milan (Italy). 1991. 15p. (CONF-9005340–1: 10. International days on Expert Systems and their Applications, Avignon (France), 28 May - 1 jun 1990). Order Number DE93729444. Source: OSTI; NTIS (US Sales Only).

The Expert System for Load Flow (SELF) assists the designer in carrying out network calculations during power system planning. More precisely, SELF is designed for the analysis of network load flow distribution. Load flow computation may fail due to non convergence of the iterative algorithm. Moreover, the computation results may violate network operating constraints (e.g., voltage lower than the minimum allowed). SELF aims at assisting the network designer in order to solve both these problems. The architecture of SELF consists of four subsystems realized using Common Lisp. The paper examines the details of the subsystem devoted to the violation elimination problem that is implemented by means of heuristic search techniques. SELF has been tested on networks of significant size (up to 420 nodes and 580 connections) showing promising results from the view point of both quality of the solutions and execution times.

2403 Power Transmission Lines and Cables

3448 (ETDE-IT–92-87) **Progress and experience on diagnostic methods for conventional and metal-oxide surge arresters.** Bargigia, A. Ente Nazionale per l'Energia Elettrica, Milan (Italy). Centro di Ricerca Elettrica. 1991. 24p. (CONF-9110438–1:

3. electric insulation workshop, Bilbao (Spain), 29-30 Oct 1991). Order Number DE93729447. Source: OSTI; NTIS (US Sales Only).

The paper presents the most recent diagnostic methods developed in Italy for conventional (gapped) and metal-oxide (gapless) surge arresters. Main requirements for these techniques are their simplicity, reliability, easiness in execution and in results interpretation. Moreover, they must not interfere with normal service operation as much as possible. For conventional surge arresters, whose most important causes of failure are to be found in the loss of housing tightness and deterioration of the grading system, the most suitable diagnostic indications seem to be obtained from variations of volt-ampere characteristics, sparkover voltage value and the leakage current waveform before sparkover. Concerning metal-oxide surge arresters, among the various possible diagnostic methods, measurements of the crest value of the total leakage current and of its third harmonic content seem to be preferable, since they are less sensitive to stray parameters.

2404 Health and Safety

Refer also to citation(s) 3448, 4429, 4430

2407 Economic, Industrial, and Business Aspects

3449 (DOE/BP–1778) **DSM Pocket Guidebook: Commercial technologies.** Brian Gard/William Lesh, Inc., Portland, OR (United States); Solar Energy Research Inst., Golden, CO (United States). Aug 1992. 117p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AM79-89BP39833. Order Number DE92040787. Source: OSTI; NTIS; INIS; GPO Dep.

It has been estimated that if electricity were used more efficiently with commercially available end-use technologies, 24%–44% of the nation's current demand for electricity could be eliminated. Almost all major electric utilities in the west are investigating such demand-side management (9DSM) opportunities. In some service territories, for example, improved efficiency could soon produce as much power as that from new coal-fired plants and produce it at a lower cost. Even utilities that currently have excess capacity are finding that DSM offers an opportunity to build efficient end-use stock to help them meet their future load shape objectives. Utility DSM programs typically consist of several measures designed to modify the utility's load shape (for example, innovative rate structures, direct utility control of loads, promotion of energy-efficient technologies, and customer education). The coordinated implementation of such measures requires planning, analysis of options, engineering, marketing, monitoring, and other coordination activities (Figure P1). This guidebook addresses one facet of an overall DSM program: selectrion of end-use technologies within the electrical utilities.

25 ENERGY STORAGE

2506 Thermal

Refer also to citation(s) 3502

3450 Microwave impregnation of porous materials with thermal energy storage materials. Benson, D.K.; Burrows, R.W. To Dept. of Energy. 13 Mar 1991. USAA patent application 7-668,52. 27p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC02-83CH10093. Order Number DE93002024. Source: OSTI; NTIS; GPO Dep.

A method for impregnating a porous, non-metallic construction material with a solid phase-change material is described. The phase-change material in finely divided form is spread onto the surface of the porous material, after which the porous material is exposed to microwave energy for a time sufficient to melt the phase-change material. The melted material is spontaneously absorbed into the pores of the porous material. A sealing chemical may also be included with the phase-change material (or applied subsequent tc the phase-change material) to seal the surface of the porous material. Fire retardant chemicals may also be included with the phase-change materials. The treated construction materials are better able to absorb thermal energy and exhibit increased heat storage capacity.

3451 (PNL-SA–20388) **H_2OTREAT: An acid for evaluating water treatment requirements for Aquifer Thermal Energy Storage.** Vail, L.W.; Jenne, E.A.; Eary, L.E. Pacific Northwest Lab., Richland, WA (United States). Aug 1992. 6p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. (CONF-920801–27: 27. intersociety energy conversion engineering conference, San Diego, CA (United States), 3-7 Aug 1992). Order Number DE93001551. Source: OSTI; NTIS; GPO Dep.

A public-domain software package is available to aid engineers in the design of water treatment systems for Aquifer Thermal Energy Storage (ATES). Geochemical phenomena that cause problems in ATES systems include formation of scale in heat exchangers, clogging of wells, corrosion in piping and heat exchangers, and degradation of aquifer materials. Preventing such problems frequently requires employing water treatment systems. Individual water treatment methods vary in cost. effectiveness, environmental impact, corrosion potential, and acceptability to regulatory bodies. Evaluating these water treatment options is generally required to determine the feasibility of ATFS systems. The H20TREAT software was developed by Pacific Northwest Laboratory for use by engineers with limited or no experience in geochemistry. At the feasibility analysis and design stages, the software utilizes a recently revised geochemical model,MINTEQ, to calculate the saturation indices of selected carbonate, oxide, and hydroxide minerals based on water chemistry and temperature data provided by the user. The saturation indices of key calcium, iron. silica, and manganese carbonates, oxides, and hydroxides (calcite, rhodochrosite, siderite, $Fe(OH)_3$[a], birnessite, chalcedony, and SiO_2) are calculated. Currently, H20TREAT does not perform cost calculations; however, treatment capacity requirements are provided. Treatments considered include (1) Na and H ion exchangers and pellet reactors to avoid calcite precipitation, and (2) in situ nitrate addition and cascade precipitation. The H20TREAT software also provides the user with guidance on other geochemical problems that must be considered, such as SiO_2 precipitation, corrosion, and environmental considerations. The sodium adsorption ratio and sodium hazard are calculated to evaluate the likelihood of clay swelling and dispersion caused by high Na concentrations. H20TREAT is available for DOS and UNIX computers.

3452 (PNL-SA–21073) **Well, hydrology, and geochemistry problems encountered in ATES systems and their solutions.** Jenne, E.A. (Pacific Northwest Lab., Richland, WA (United States)); Andersson, O.; Willemsen, A. Pacific Northwest Lab., Richland, WA (United States). Aug 1992. 20p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. (CONF-920801–28: 27. intersociety energy conversion engineering conference, San Diego, CA (United States), 3-7 Aug 1992). Order Number DE93001300. Source: OSTI; NTIS; INIS; GPO Dep.

In aquifer thermal energy storage (ATES) systems, wells provide the interface between the energy storage and use. Efficient operational wells are, therefore, essential for the system to run at maximum (design) efficiency. Adequate test drilling to accurately predict aquifer properties is essential in the design phase; proper construction and development are crucial; and proper monitoring of performance is necessary to identify the early stages of clogging and to evaluate the adequacy of well rehabilitation. Problems related to hydrology, well, and aquifer properties include: loss of permeability resulting from gas exsolution, chemical precipitation, and dispersion and movement of fine-grained particles; loss of recoverable heat caused by excessive regional ground-water gradient, hydrodynamic mixing of injected and native ground water, buoyancy flow and heat conduction through the cap and base of the storage zone; leakage up along the well casing; and "fracturing" of a shallow upper aquiclude as a result of an injection pressure greater than the hydrostatic pressure on the aquiclude. The predominant geochemical problems encountered are precipitation of carbonates in some areas and iron plus manganese oxides in others. These precipitation problems can be anticipated, and thus avoided, via geochemical calculations. The likelihood of iron

carbonate precipitation is less certain because of the lack of adequate research. Corrosion is a frequent problem. Most of the hydrochemically related clogging and corrosion problems that have been encountered in ATES systems can be predicted and avoided by appropriate design, construction, and operation of new ATF-S systems, assuming that appropriate hydrologic and geochemical modeling is carried out in advance. It is prudent to carefully consider the need for water treatment and to anticipate that there will be some increase in injection pressure and decrease of specific capacity over time.

2508 Chemical

Refer also to citation(s) 3833, 3838

2509 Batteries

3453 (SAND–92-1611) **Durability of carbon-plastic electrodes for zinc/bromine storage batteries.** Arnold, C. Jr. Sandia National Labs., Albuquerque, NM (United States). Oct 1992. 25p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-76DP00789. Order Number DE93003224. Source: OSTI; NTIS; GPO Dep.

In previous work, failure of early versions of the zinc/bromine battery was traced to degradation and warpage of the carbon-plastic electrode. These electrodes were fabricated from copolymers of ethylene and propylene (EP) containing structures that were found to be susceptible to degradation by the electrolyte. In this work, we evaluated two developmental electrodes from Johnson Controls Battery Group, Inc., in which the EP copolymer was replaced with a high-density polyethylene (HDPE) that contained glass-fiber reinforcing fillers. The glass fiber content of these two electrodes was different (19% vs. 31%). We determined the effect of electrolyte on sorption behavior, dimensional stability, chemical stability, and thermal, mechanical, and electrical properties under real-time and accelerated aging conditions. We also characterized unaged samples of both electrodes to determine their chemical composition and physical structure. We found that high glass content in the electrode minimizes sorption and increases dimensional stability. Both high and low glass content electrodes were found to be chemically and thermally stable toward the electrolyte. A slight decrease in the storage modulus (G′) of both electrodes was attributed to sorption of non-ionic and hydrophobic ingredients in the electrolyte. The electrical conductivity of both electrodes appeared to improve (increase) upon exposure to the electrolyte. No time or temperature trends were observed for the chemical, thermal, or mechanical properties of electrodes made from HDPE. Since decreases in these properties were noted for electrodes made from EP copolymers under similar conditions, it appears that the HDPE-based electrodes have superior long-term stability in the $ZnBr_2$ environment.

3454 (SAND–92-1658) **5AH10 Nickel-Cadmium (NiCad) Battery Maintenance Tester: User's manual.** Justice, L.B.; Wakefield-Reyes, C. Sandia National Labs., Albuquerque, NM (United States). Aug 1992. 955p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-76DP00789. Order Number DE93004001. Source: OSTI; NTIS; GPO Dep.

This manual is a user's guide to the SE3253 and SE3254 versions of the 5AH10 Battery Maintenance Tester, a charger/discharger and test system for the 24-Cell 5-Ah Nickel-Cadmium Battery Pack. The manual provides information on rack equipment, power, communications, theory of operations, user interface, and operating procedures. Copies of users manuals for all equipment comprising the Battery Maintenance Tester are included as appendices.

29 ENERGY PLANNING AND POLICY

Refer also to citation(s) 4772

3455 (DOE/CE/15982–T1) **Survey of Independent Inventors: An overview.** Whalley, P. Loyola Univ., Chicago, IL (United States). [1992]. 31p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG02-90CE15982. Order Number DE93003265. Source: OSTI; NTIS; GPO Dep.

Independent inventors are important but little-researched members of the US technical community. The survey reported on here is the first in modern times to attempt to provide a profile of the US independent inventor that goes beyond a single geographical or organizational locale. The report that follows provides an overview of the demographics, practices and concerns of the modern US inventor as represented by the members of leading US inventor organizations. It is by no means comprehensive but seeks to be indicative of the issues raised in the survey each which will be dealt with more comprehensively in future publications.

3456 (DOE/CE/15984–T1) **Systematized contact between inventors and industry: Final technical report.** Technology Targeting, Inc., Salt Lake City, UT (United States). 31 Jul 1992. 14p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG02-90CE15984. Order Number DE93003280. Source: OSTI; NTIS; GPO Dep.

A total of 139 inventions by private (individual) inventors were submitted to Technology Targeting Incorporated. Each inventor was told of the nature of the DOE-supported Project, through informational and promotional efforts by TTI, and each completed an Invention Submittal Form developed by TTI to describe the essential nature of the claimed invention. Many also submitted detailed descriptions, drawings, technical reports and similar supplemental materials giving a more comprehensive view of their inventions. Each invention was reviewed for technical and commercial merit, as well as for appropriateness of marketing through the Technology Targeting DataBase™ (hereafter "DATABASE). Overall, participating inventors were enthusiastic about the Project and felt participation in it was rewording. Even when not selected for marketing, inventors were given an analysis of their inventions which could help them enhance the inventions and improve marketing efforts. Inventors whose inventions were selected for marketing were shown how to professionally market the inventions, including the format for Non Confidential Invention Summaries, the preferred form for Confidential Disclosure Agreements, targeting of business decision-makers responsible for technology evaluation, and the like; some of these inventors are still interacting with industrial contacts provided by TTI through this Project. All inventors received copies of patent abstracts uncovered in the prior art searches for their inventions and a copy of TTI's booklet, Patent Law Basics for Individual Inventors.

3457 (DOE/EIA–0036(92/10)) **Monthly energy review, October 1992.** USDOE Energy Information Administration, Washington, DC (United States). Office of Energy Markets and End Use. 27 Oct 1992. 166p. Sponsored by USDOE, Washington, DC (United States). Order Number DE93002636. Source: OSTI; NTIS; GPO; GPO Dep.

The Monthly Energy Review gives information on production, distribution, and consumption for various energy sources, e.g. petroleum, natural gas, oil, coal, electricity, and nuclear energy. Some data is also included on international energy sources and supplies, the import of petroleum products into the US and pricing and reserves data (as applicable) for the various sources of energy listed above.

3458 (DOE/EIA–0173(91)) **Energy Information Administration annual report to Congress, 1991.** USDOE Energy Information Administration, Washington, DC (United States). 4 Mar 1992. 79p. Sponsored by USDOE, Washington, DC (United States). Order Number DE93002214. Source: OSTI; NTIS; GPO; GPO Dep.

Created by Congress in 1977 as an independent entity within the Department of Energy, the Energy Information Administration (EIA) is the principal and authoritative source of comprehensive energy data for the Congress, the Federal Government, the States, and the public. During 1991, EIA was called upon for information and analysis required by policymakers dealing with many energy-related issues, including the Persian Gulf War, the adequacy of propane supplies during the winter heating season, issues arising from the Clean Air Act, and implementation of the Department's National Energy Strategy.

3459 (DOE/ER/75682–1-Pt.2) **Kansas energy 2000: DOE/EPSCoR: Survey of the use of energy-related information by Kansas businesses: [Progress report].** Legg, J.; Nellis, D.; Simons, G. Kansas State Univ., Manhattan, KS (United States). Mar 1992. 42p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG02-91ER75682. Order Number DE93001486. Source: OSTI; NTIS; GPO Dep.

the objective of the survey of Kansas businesses was to examine the nature of involvement and extent of interest by private industry in energy-related programs. The survey contained four major sections. The first section examined the policies of private industry in hiring graduates from Kansas universities and colleges for work in energy-related research and development (R&D) and in providing internships and educational enhancement programs for in-state employees. The second section examined the sources of energy-related information used by private industry located in Kansas. The third section examined research relationships between Kansas universities and colleges and private companies in the provision of funding support for academic research programs in energy-related areas. The fourth section examined the extent of interest in establishing university research relationships among companies that were not currently funding energy-related research at Kansas universities and colleges.

3460 (DOE/ER/75682–1-Pt.3) **Kansas energy 2000 DOE/EPSCoR: Inventory of energy related assets.** Legg, J.; Nellis, D.; Simons, G. Kansas State Univ., Manhattan, KS (United States). Mar 1992. 159p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG02-91ER75682. Order Number DE93001487. Source: OSTI; NTIS; GPO Dep.

The US Department of Energy is one of several federal agencies which has initiated an Experimental Program to Stimulate Competitive Research (EPSCoR). Generally, this program is intended to enhance the competitive ability of states that are under-represented in the receipt of funds for research from federal agencies. Kansas State University, The University of Kansas, and Wichita State University, have received support from the US Department of Energy to begin the EPSCoR process in Kansas. The specific purposes of the DOE/EPSCoR program are to enhance the capability of Kansas to develop science and engineering personnel in energy-related areas and to conduct nationally competitive energy-related research. The inventory contains two general categories of data. First, surveys of individuals and campus units involved in energy-related activities were conducted at Kansas State University, The University of Kansas, and Wichita State University. Second, a survey was conducted of a sample of businesses in the state of Kansas involved in energy-related or energy-intensive activities.

3461 (DOE/S–0096P) **National Energy Strategy: Technical Annex 5, Analysis of options to increase exports of US energy technology, 1991–1992.** USDOE, Washington, DC (United States). [1992]. 115p. Sponsored by USDOE, Washington, DC (United States). Order Number DE93001379. Source: OSTI; NTIS; GPO Dep.

The National Energy Strategy (NES) seeks to increase the participation of the Federal Government in the technology transfer process, and exporting energy technology could be an effective means for transferring US energy technology to the world. This report provides a substantive assessment of the potential for expanding the exports of US energy technologies and services, especially in four key technology areas: power generation, transmission, and distribution; oil and gas exploration and production; energy efficiency; and emerging energy technologies. This assessment provided the baseline for identifying and evaluating various NES policy options that could be considered at the Federal level for facilitating energy technology exports.

3462 (DOE/S–0101P) **US Department of Energy semiannual report to Congress on Inspector General audit reports, April 1–September 30, 1992.** USDOE, Washington, DC (United States). Nov 1992. 21p. Sponsored by USDOE, Washington, DC (United States). Source: OSTI (Free of Charge).

This is the Secretary of Energy's seventh Semiannual Report to Congress to be submitted under the Inspector General Act of 1978, as amended. Pursuant to the Inspector General Act Amendments of 1988 (Public Law 100-504), agency heads are to report to Congress on the status of final action taken on audit report recommendations. This report complements a report prepared by the Department's Office of Inspector General (IG), which provides information on audit reports issued during the period and on the status of management decisions made on IG audit reports. This report has three sections. The first outlines significant management accomplishments achieved by the Department during the reporting period. The second section contains the statistical tables that illustrate the status of final action on IG audit reports. The third lists the audit reports which are one year or more past management decision and have not completed final action. This section also provides the status of corrective actions on each of these reports.

2901 Energy Analysis and Modeling

3463 (ECN-I–92-030) **Characterization of energy conversion processes in the National Energy Outlooks 1990-2015.** Van Arkel, W.G. Netherlands Energy Research Foundation (ECN), Petten (Netherlands). Jul 1992. 60p. (In Dutch). Order Number DE92557276. Source: OSTI; NTIS (US Sales Only).

By means of the energy model SELPE computer calculations can be carried out within the framework of the scenario study National Energy Outlooks 1990-2015 (NEV in Dutch). The SELPE model describes the Dutch energy economy by means of a large number of equations. More than 360 processes can be distinguished for the NEV. In this case a process is an energy system, equipped with air pollution abatement technical systems. For every process a sheet has been made presenting relevant data. The sheets are collected in one file, accompanied by an explanation and an extended index. The contents of the file, which was composed in January 1992, are described in chapter three of this report. Within the framework of the development of the NEV-Information System (NEV-IS) software has been designed by which characteristic process data can be manipulated. This software will be available mid-1992. In chapter two attention is paid to the different processes, which can be distinguished within the SELPE model, based on different energy conversion techniques, the fuel options, and the sectors where the processes are used. Also attention is paid to the possibilities to abate and/or reduce air pollution. 4 figs., 3 tabs., 5 apps., 13 refs.

2902 Economics and Sociology

Refer also to citation(s) 3479, 3486, 3501, 4182

2903 Environment, Health, and Safety

Refer also to citation(s) 2729, 2831, 2907, 3540, 3675, 3707, 3719, 3754, 4111, 4188, 4380

3464 (CONF-9108221–1) **A two-sector model of land use and deforestation: Funding urban development with a tax on urban and rural employment.** Jones, D.W.; O'Neill, R.V. Oak Ridge National Lab., TN (United States). 17 Jul 1992. 14p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. From 1991 symposium on some mathematical question in biology; San Antonio, TX (United States); 8 Aug 1991. Order Number DE93000429. Source: OSTI; NTIS; GPO Dep.

We model a small country with an urban manufacturing sector and a rural agricultural sector. Government taxes rural and urban employment to finance urban infrastructure which contributes to urban production. The manufacturing wage is fixed, leading to urban unemployment. Expansion of cultivated area involves deforestation at frontiers. An increment to urban infrastructure may draw resources into the city but a large enough addition to infrastructure may cause the tax rate to rise by more than urban labor productivity, which would exacerbate frontier deforestation. Improvement of rural transportation raises rural wages, reduces the urban unemployment rate, and extends the area under cultivation, causing deforestation; it also reduces the employment tax rate, which permits expansion of fixed-wage urban manufacturing. Such a wide, sectoral distribution of benefits may help explain the popularity of such policies despite their damage to frontier forest resources.

3465 (CONF-9109358–, pp. 6) **Oversight of the implementation of environmental laws by the United States House of**

Representatives. Jacobson, D.A. USDOE, Washington, DC (United States). [1991]. From 8. international conference on chemistry for protection of the environment; Lublin (Poland); 16-18 Sep 1991. In *Chemistry for protection of the environment, Eight international conference: Proceedings.* 635p. Order Number DE92014317. Source: OSTI; NTIS; INIS.

This presentation will review American constitutional history and legal precedents concerning the power of the legislature to obtain information from the executive branch of government. This background will serve as a basis for exploring the importance of legislative oversight in assuring the effective implementation of environmental laws in the United States. Particular emphasis will be focused on oversight of the United States laws governing the disposal and cleanup of hazardous wastes during the past decade. These laws include the Resource Conservation and Recovery Act and the Comprehensive Environmental Response, Compensation, and Liability Act (Superfund Act). The presenter will emphasize that the benefits of enacting environmental legislation may be limited unless the legislative branch of government exercises its authority to secure information from the executive branch about the details of enforcement and administration of such laws.

3466 (CONF-9109358–, pp. 25) **Innovative clean technology case studies in Alexandria, Egypt.** Hamza, A. (Alexandria University (Egypt)). USDOE, Washington, DC (United States). [1991]. From 8. international conference on chemistry for protection of the environment; Lublin (Poland); 16-18 Sep 1991. In *Chemistry for protection of the environment, Eight international conference: Proceedings.* 635p. Order Number DE92014317. Source: OSTI; NTIS; INIS.

Industrial development in Alexandria Metropolitan Area AMA has grown significantly during the last three decades to benefit from interindustry linkages and the supporting infrastructure in this prime industrial center. Whilst industrialization is encouraged to advance economic growth and to improve standards of living in AMA, the rate of change accentuates the impacts on public health and the environment. At present, it has become obvious that environmental degradation, associated with vast industrial and socio-economic development, if allowed to proceed without appropriate control, could result in devastating effects on the living conditions and on natural resources of the region. Financial constraints represents an impediment to development in AMA; the question often addressed by local authorities, is whether to allocate funds to treat industrial wastes or to invest in new Clean Technologies (CT). Considerations of resources conservation, economic efficiency and environmental protection warrant the adoption, as far as possible, of a preventive strategy.

3467 (CONF-9109358–, pp. 48) **Evaluating potential environmental liabilities.** Veale, F.J. Jr. (Texas Instruments Incorporated, Attleboro, MA (United States)). USDOE, Washington, DC (United States). [1991]. From 8. international conference on chemistry for protection of the environment; Lublin (Poland); 16-18 Sep 1991. In *Chemistry for protection of the environment, Eight international conference: Proceedings.* 635p. Order Number DE92014317. Source: OSTI; NTIS; INIS.

Over the past decade, as a result of heightened public awareness regarding environmental concerns, the United States has proliferated numerous federal and state environmental statutes along with regulations implementing them. These enactments attempt to address all areas of environmental concern. In many cases the laws within one area will overlap into another and, therefore, cannot be viewed as separate entitles. Environmental liability is 'strict, joint and several, absolute and retroactive'. Today's liabilities go beyond the 'polluter pays' principle. Under 'absolute' liability an industry may be held liable for the acts of another. Just by virtue of being a landowner of lessee, certain claims may need to be addressed which could bankrupt an industry. It is imperative for an industry involved in manufacturing to review potential liabilities under all environmental laws. Not only at the time of acquisition but throughout the life of the industry, a constant diligent review of past, present and anticipated future environmental requirements must be maintained. Any facility which emits air contaminants, discharges water pollutants, utilizes toxic substances, manage and disposes of hazardous waste may incur serious environmental liabilities. It is the duty of those entrusted with the well being of a corporation to ensure knowledge and compliance with environmental concerns.

3468 (CONF-9109358–, pp. 2) **Health concerns associated with environmental contamination due to injudicious disposal of hazardous wastes.** Cech, I. (The University of Texas Health Science Center, Houston (United States)). USDOE, Washington, DC (United States). [1991]. From 8. international conference on chemistry for protection of the environment; Lublin (Poland); 16-18 Sep 1991. In *Chemistry for protection of the environment, Eight international conference: Proceedings.* 635p. Order Number DE92014317. Source: OSTI; NTIS; INIS.

At issue is finding appropriate strategies to deal with hazardous wastes and methods to protect human health and the environment. However, in situations when industrial productivity concerns supersede other considerations, environmental protection often is given low priority. Evidence of uncontrolled releases of hazardous substances can be found in many parts of the world and examples in this presentation will be drawn from experiences in the United States, Mexico, and Central America, as well as Central And Eastern Europe. Also acknowledged in these examples will be limitations inherent in efforts to establish causal relationships between human exposure to hazardous substances and increased prevalence of adverse health outcomes. These limitations of the scientific evaluation methods are particularly obvious when dealing with simultaneous effects of several chemicals and complex chemical mixtures, such as exist at most hazardous waste disposal sites.

3469 (DOE/EH–0284) **Environmental Audit of the Alaska Power Administration.** USDOE Assistant Secretary for Environment, Safety, and Health, Washington, DC (United States). Office of Environmental Audit. Oct 1992. 190p. Sponsored by USDOE, Washington, DC (United States). Order Number DE93002857. Source: OSTI; NTIS; INIS; GPO Dep.

This report documents the results of the Comprehensive Baseline Environmental Audit of the Alaska Power Administration (APA) headquartered in Juneau, Alaska. This Audit was conducted by the US Department of Energy's (DOE's) Office of Environmental Audit (EH-24) from August 24 to December 8, 1992. The scope of the Audit was comprehensive, covering all environmental programs and activities with the exception of those relating to the National Environmental Policy Act (NEPA). Specifically considered was the compliance status of APA regarding Federal, state, and local statutes and regulations, DOE Orders and Directives, and best management practices. The technical disciplines addressed by the Audit were: air, surface water/drinking water, groundwater, waste management, toxic and chemical materials, quality assurance, inactive waste sites, and environmental management. Due to the nature of the activities carried out at the two Federal hydroelectric projects operated by APA, the area of radiation was not investigated during the Audit.

3470 (DOE/EH–0285) **Environment, Safety and Health Progress Assessment of the Mound Plant.** USDOE, Washington, DC (United States). Oct 1992. 196p. Sponsored by USDOE, Washington, DC (United States). Order Number DE93002860. Source: OSTI; NTIS; GPO Dep.

This report documents the result of the US Department of Energy (DOE) Environment, Safety and Health (ES&H) Progress Assessment of the Mound Plant in Miamisburg, Ohio. The assessment, which was conducted from August 24 through September 4, 1992, included a selective review of the ES&H management systems and programs of the Office of the Assistant Secretary for Defense Programs (DP), Albuquerque Field Office (AL), Dayton Area Office (DAO), and the site contractor EG&G Mound Applied Technologies (EG&G Mound). The ES&H Progress Assessments are part of the Secretary of Energy's continuing effort to institutionalize line management accountability and the self-assessment process throughout DOE and its contractor organizations. The purpose of the Mound Plant ES&H Progress Assessment is to provide the Secretary with an independent assessment of the adequacy and effectiveness of the DOE and contractor management structures, resources, and systems to address ES&H problems and requirements. The main mission of the Mound Plant is to manufacture both non-nuclear and tritium-containing components for

nuclear weapons that are assembled at other DOE sites. A summary of issues and progress in the areas of environment, safety and health, and management are included.

3471 (ECN-RX–92-026) **National Energy Policy and Climate Change Prevention: The role of new energy technologies.** Bruggink, J.J.C. (Netherlands Energy Research Foundation, Petten (Netherlands)); Mallant, R.K.A.M.; Van der Wart, R.; Muradin-Szweykowska, M. Netherlands Energy Research Foundation (ECN), Petten (Netherlands). Jun 1992. 15p. Order Number DE92557265. Source: OSTI; NTIS (US Sales Only); INIS.

Paper to be presented at the 15th congress of the World Energy Council in Madrid (Spain), on September 20 to 25, 1992.

Climate change prevention has become one of the major concerns of environmental policy in the Netherlands. The Dutch government has set definite targets for CO_2 emissions in the coming decade. These targets and the measures necessary to reach them are described in the paper. In addition, the technical feasibility of realizing the Toronto objective of a 20% reduction in CO_2 emissions by the year 2005 in the Netherlands is discussed. It appears that energy conservation options are most crucial for the short-term, but that eventually new supply technologies are needed to obtain drastic reductions in the long term. The increased need for research and development efforts has led to two innovative research programmes on sustainable energy development in the Netherlands. The ENGINE (ENergy Generation In the Natural Environment) programme is implemented by the Netherlands Energy Research Foundation (ECN) and addresses the specific problems associated with the three major components of supply: cleanliness in the case of fossil fuels, safety in the case of nuclear energy, and costs in the case of renewable sources. The complementary SYRENE (SYstem integration of Renewable ENergy and End use) is implemented by the Netherlands Agency for Energy and Environment (NOVEM) and addresses the system aspects of sustainable energy development. The objectives and approaches of these two programmes are briefly presented. 1 fig., 1 tab., 4 refs.

3472 (ETDE-mf–93728739) **The greenhouse problem - a global challenge. 2nd report of the Working Committee 'Energy Supply' of the Interministerial Working Group 'CO_2 Reduction'.** BMWi-Studienreihe. Bundesministerium fuer Wirtschaft, Bonn (Germany). Dec 1991 42p. (In German). Order Number DE93728739. Source: OSTI; NTIS (US Sales Only).

After sketching the point of departure in 1991, the paper reports on the state of implementation of the Cabinet Decision of November 7, 1990. The bundle of measures pursued to date by Federal Government is analysed from the point of view of energy policy and with regard to structural changes. The results of current forecasts of the development of energy consupmtion and CO_2 emissions are discussed. The paper furthermore contains complementary proposals for an integrative CO_2 reduction concept on the basis of the conditions prevailing in a market economy, and reports on the state of international discussion pertinent to CO_2 reduction in the energy sector. (orig.).

3473 (GB–448) **The impacts and costs of global warming: A review.** Energy and Environment Paper. Eyre, N.J. AEA Environment and Energy, Harwell (United Kingdom). Sep 1991 39p. Order Number DE93733559. Source: OSTI; NTIS (US Sales Only); INIS.

There is now a scientific consensus that current rates of accumulation of greenhouses gases in the atmosphere will result in significant global warming and climate change. These changes are likely to have important impacts on a wide range of human activities and the natural environment. There has now been a considerable weight of literature published on the impacts of global warming, much of it very recent. This report seeks to summarise the important results, to analyse the uncertainties and to make a preliminary analysis of the feasibility of monetarising these environmental costs. The impacts of global warming are divided into ten major categories: agriculture, forests and forestry, terrestrial ecosystems and biodiversity, hydrology and water resources, sea level rise and coastal zones, energy, infrastructure/transport/industry, human health and air quality, oceans, and cryospheric impacts. The results of major summary reports are analysed, notably the report of Working Group II of the Intergovernmental Panel on Climate Change (the IPCC). (author).

3474 (MAFF-FRDR–27) **Monitoring of radioactivity in the UK environment: an annotated bibliography of current programmes.** Cotter, A.J.R. (Ministry of Agriculture, Fisheries and Food, Lowestoft (United Kingdom). Directorate of Fisheries Research); Hunt, G.J.; Myatt, A.; Walters, C.B. Ministry of Agriculture, Fisheries and Food, Lowestoft (United Kingdom). Directorate of Fisheries Research. 1992. 51p. Order Number DE93607329. Source: OSTI; NTIS (US Sales Only); INIS.

In the UK, many organisations carry out regular radioactivity monitoring programmes, and summaries of these programmes have been published in 1983 and 1988. The number of organisations carrying out radioactivity monitoring has increased rapidly in recent years, particularly in the local authority sector. The present report updates the previous summarises in the form of an annotated bibliography, giving synopses of all regular UK programmes whose results are published in report form. (author).

3475 (NREL/TP–262-4680) **Environmental, health, and safety issues of sodium-sulfur batteries for electric and hybrid vehicles: Volume 2, Battery recycling and disposal.** Corbus, D. National Renewable Energy Lab., Golden, CO (United States). Sep 1992. 35p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC02-83CH10093. Order Number DE92016432. Source: OSTI; NTIS; GPO Dep.

Recycling and disposal of spent sodium-sulfur (Na/S) batteries are important issues that must be addressed as part of the commercialization process of Na/S battery-powered electric vehicles. The use of Na/S batteries in electric vehicles will result in significant environmental benefits, and the disposal of spent batteries should not detract from those benefits. In the United States, waste disposal is regulated under the Resource Conservation and Recovery Act (RCRA). Understanding these regulations will help in selecting recycling and disposal processes for Na/S batteries that are environmentally acceptable and cost effective. Treatment processes for spent Na/S battery wastes are in the beginning stages of development, so a final evaluation of the impact of RCRA regulations on these treatment processes is not possible. The objectives of tills report on battery recycling and disposal are as follows: Provide an overview of RCRA regulations and requirements as they apply to Na/S battery recycling and disposal so that battery developers can understand what is required of them to comply with these regulations; Analyze existing RCRA regulations for recycling and disposal and anticipated trends in these regulations and perform a preliminary regulatory analysis for potential battery disposal and recycling processes. This report assumes that long-term Na/S battery disposal processes will be capable of handling large quantities of spent batteries. The term disposal includes treatment processes that may incorporate recycling of battery constituents. The environmental regulations analyzed in this report are limited to US regulations. This report gives an overview of RCRA and discusses RCRA regulations governing Na/S battery disposal and a preliminary regulatory analysis for Na/S battery disposal.

3476 (NREL/TP–463-4951) **Environmental, health, and safety issues of sodium-sulfur batteries for electric and hybrid vehicles: Volume 3, Transport of sodium-sulfur and sodium-metal-chloride batteries.** Hammel, C.J. National Renewable Energy Lab., Golden, CO (United States). Sep 1992. 23p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC02-83CH10093. Order Number DE92016443. Source: OSTI; NTIS; GPO Dep.

This report examines the shipping regulations that govern the shipment of dangerous goods. Since the elemental sodium contained in both sodium-sulfur and sodium-metal-chloride batteries is classified as a dangerous good, and is listed on both the national and international hazardous materials listings, both national and international regulatory processes are considered in this report The interrelationships as well as the differences between the two processes are highlighted. It is important to note that the transport regulatory processes examined in this report are reviewed within the context of assessing the necessary steps needed to provide for the domestic and international transport of sodium-beta batteries. The need for such an assessment was determined by the Shipping Sub-Working Group (SSWG) of the EV Battery Readiness Working Group (Working Group), created in 1990. The Working Group was

created to examine the regulatory issues pertaining to in-vehicle safety, shipping, and recycling of sodium-sulfur batteries, each of which is addressed by a sub-working group. The mission of the SSWG is to establish basic provisions that will ensure the safe and efficient transport of sodium-beta batteries. To support that end, a proposal to the UN Committee of Experts was prepared by the SSWG, with the goal of obtaining a proper shipping name and UN number for sodium-beta batteries and to establish the basic transport requirements for such batteries (see the appendix for the proposal as submitted). It is emphasized that because batteries are large articles containing elemental sodium and, in some cases, sulfur, there is no existing UN entry under which they can be classified and for which modal transport requirements, such as the use of packaging appropriate for such large articles, are provided for. It is for this reason that a specific UN entry for sodium-beta batteries is considered essential.

2904 Energy Resources

3477 (ANL/CP–77470) **Energy foundations for sustainable development.** Sather, N.F. Argonne National Lab., IL (United States). [1992]. 2p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-31109-ENG-38. (CONF-9209160–13: International symposium on energy, environment and information management, Argonne, IL (United States), 15-18 Sep 1992). Order Number DE92041088. Source: OSTI; NTIS; INIS; GPO Dep.

Worldwide, more than three-quarters of our energy needs are obtained from nonrenewable reserves of coal, oil, gas, and uranium. The unavoidable outcome of our present path is the depletion of all non-renewable energy resources. Further exacerbating the energy picture is the mounting cost of mitigating the adverse environmental and health impacts of energy use. Problems ranging from acid rain and radioactive waste storage to the potential for widespread environmental disaster that could result from the buildup of greenhouse gases in the atmosphere have made it that the earth's capacity to absorb the waste products of energy use without serious consequences is being severely strained. Potential supply shortages and mounting costs for the energy component of our industrial enterprise will increasingly undermine our ability to sustain global economic development. Strong positive actions that shore up the energy foundations of our economy arc called for. The purpose of this presentation is to focus attention on two such proactive steps which, though insufficient to the task by themselves, are nevertheless crucial to any effective plan for heading off the recessionary tendencies of our growing energy supply and cost dilemma. The first of these essential steps is to develop a much better arrangement than we currently have for including all costs for the adverse health and environmental impacts of industrial production in the price paid by consumers for fuels, electricity, and manufactured goods. The second essential action is to expand our R&D effort to develop new manufacturing processes and new materials and products that meet our needs for power, fuels and consumer goods at lower cost, greater efficiency, and with reduced environmental cost.

2905 Research, Development, Demonstration, and Commercialization

Refer also to citation(s) 2812, 3455, 3456, 3459, 3460, 4264

3478 (CONF-9203189–) **The 1992 conference on Latin America's Energy Industry: New opportunities for growth through international investment and trade.** Institute of the Americas, La Jolla, CA (United States). [1992]. 464p. Sponsored by USDOE, Washington, DC (United States). From Latin American energy industry: new opportunities for growth through international investment and trade; La Jolla, CA (United States); 8-10 Mar 1992. Order Number DE93001385. Source: OSTI; NTIS; GPO Dep.

Liberal economic and political reforms in Latin America, a declining oil market in the US, and world events such as last year's Persian Gulf Crisis are making foreign investment in Latin America's energy sector increasingly attractive. The Persian Gulf crisis indicated the US must diversify oil sources; increased competition and deregulation in electric power generation and gas production are providing more opportunities for independent power producers at home and abroad; and Latin America's need for foreign financial and technical assistance are providing an important "pull" factor. Electricity needs in the developing world wig be huge in the years to come. In Latin America and the Caribbean, 66,500 mg of new capacity will be required by 1999. The developing world will require US $100 billion in energy investment a year. But Latin American countries will have trouble obtaining funds. The region will need to rely heavily on private international sources to finance future energy requirements. Multilateral development bank participation win remain critical, however, serving as a catalyst for government reform and private investment in the sector. In particular, World Bank lending will be focused on countries with a clear commitment to pricing reform, regulatory reform, competitive markets, non-market barriers, and technology transfer. Opportunities for foreign participation in the Latin American oil sector are particularly large in Ecuador, Peru, Argentina, and Venezuela. Mexico's plans for reform in the oil sector, a delicate issue in that country, appear to be less defined and likely to occur farther into the future. The conference made clear that a regulatory entity is needed even when the sector is owned by the government. Regulatory processes must be fair and transparent in order to ensure adequate financial and technical performance.

3479 (DOE/CE/15983–T1) **Developing an inventor support service which performs early stage market and manufacturing evaluations: Final report.** Innovative Products Research and Services, Inc., Lexington, MA (United States). Oct 1991. 193p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG02-90CE15983. Order Number DE93002523. Source: OSTI; NTIS; GPO Dep.

American businesses are learning the difficult high cost lesson of ignoring production and market factors (producibility, unit product cost (UPC), marketability, etc) during the engineering design phase of product development. Studies have shown that the Japanese spend three times as long as Americans in the design feasibility and decision process of new product introductions and one third the amount of time in the implementation of those products. There is a 20 to 1 cost benefit on effort applied in the design phase versus the production phase of the product life cycle. The number one goal of this project was to establish an organization that has, as one of its purposes, the providing of services responsive to the needs of independent inventors. The number two goal was to demonstrate the value of providing marketing and manufacturing counsel at an early stage in the product development process. The first study goal was met by providing the materials and information necessary to establish an evaluation team and an organization to handle such evaluations. The second study goal was met by demonstrating the impact of early market analysis and manufacturing considerations on product design and therefore on the description of the invention for four different inventions. These inventions were selected at various stages of development. Regardless of stage of development, the marketing and manufacturing reviews resulted in significant changes in design and/or market positioning.

3480 (DOE/EM–50022-H1) **Directory of Federal Agencies and University Research Centers conducting R&D in Environmental and Waste Management.** PAR Enterprises, Inc., Clifton, VA (United States). Dec 1991. 254p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC01-90EW50022. Source: OSTI (Free of Charge).

In October 1990 PAR Enterprises, Incorporated was awarded a contract by the Department of Energy to conduct a survey and prepare a Directory of Federal Agencies and University Research Centers involved in environmental restoration and waste management research and development. To conduct the survey and organize the Directory, data from 50 Federal agencies and 100 universities was collected, evaluated and summarized. The purpose of the survey and Directory is to describe the activities and provide a reference base of Federal Agencies and University Research Cantors involved in environmental restoration and waste management research and development. The Directory contains (1) the Foreword, (2) an Introduction, (3) a Description of the Survey Organization and Research Approach, (4) the EM/OTD Key Word Networks, (5) a series of matrices that show the relationship

between the OTD technical requirements and the Federal Agency/ University EM capabilities, (6) the Federal Agency and University Research Center EM R&D Capabilities Profiles, (7) a Glossary, and (8) an Appendix that describes the EM activities of the DOE National Laboratories and related research facilities. The survey and Directory was prepared for the Office of Technology Development (OTD), a major R&D component of DOE's Office of Environmental Restoration and Waste Management.

3481 (DOE/ER/75682–1-PT.1) **Kansas energy 2000: Inventory of energy related assets, University of Kansas.** Legg, J.; Nellis, D.; Simons, G. Kansas State Univ., Manhattan, KS (United States). Inst. for Social and Behavioral Research. Mar 1992. 111p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG02-91ER75682. Order Number DE93001485. Source: OSTI; NTIS; GPO Dep.

The US Department of Energy is one of several federal agencies which has initiated an Experimental Program to Stimulate Competitive Research (EPSCoR). Generally, this program is intended to enhance the competitive ability of states that are underrepresented in the receipt of funds for research from federal agencies. Kansas State University, The University of Kansas, and Wichita State University, have received support from the US Department of Energy to begin the EPSCoR process in Kansas. The specific purposes of the DOE/EPSCoR program are to enhance the capability of Kansas to develop science and engineering personnel in energy-related areas and to conduct nationally competitive energy-related research. The information presented in the various documents included in this report reflects an inventory of existing energy-related assets in Kansas. The inventory includes both a description of the existing energy research infrastructure in Kansas and recommendations regarding how existing assets can be mobilized and enhanced in order to promote nationally competitive energy-related research, education, and extension. The inventory contains two general categories of data. First, surveys of individuals and campus units involved in energy-related activities were conducted at Kansas State University, The University of Kansas, and Wichita State University. Second, a survey was conducted of a sample of businesses in the state of Kansas involved in energy-related or energy-intensive activities.

3482 (DOE/ER/75682–1-Pt.5) **Kansas energy 2000: Inventory of energy related assets, research area summary, Kansas State University, University of Kansas, Wichita State University: Volume 1.** Legg, J.; Nellis, D.; Simons, G. Kansas State Univ., Manhattan, KS (United States). Inst. for Social and Behavioral Research. Mar 1992. 209p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG02-91ER75682. Order Number DE93001489. Source: OSTI; NTIS; GPO Dep.

Volume I contains brief description of researches in basic energy research and environmental research.

3483 (PNL-SA–21348) **Tech transfer outreach: An informal proceedings of the first technology transfer/communications conference.** Liebetrau, S. (ed.). Pacific Northwest Lab., Richland, WA (United States). [1992]. 45p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. (CONF-9205241–: 1. technology/communications conference: tech transfer outreach, Richland, WA (United States), 19-21 May 1992). Order Number DE93001553. Source: OSTI; NTIS; GPO Dep.

This document provides an informal summary of the conference workshop sessions. "Tech Transfer Outreach!" was originally designed as an opportunity for national laboratory communications and technology transfer staff to become better acquainted and to discuss matters of mutual interest. When DOE field office personnel asked if they could attend, and then when one of our keynote speakers became a participant in the discussions, the actual event grew in importance. The conference participants–the laboratories and DOE representatives from across the nation–worked to brainstorm ideas. Their objective: identify ways to cooperate for effective (and cost-effective) technology transfer outreach. Thus, this proceedings is truly a product of ten national laboratories and DOE, working together. It candidly presents the discussion of issues and the ideas generated by each working group. The issues and recommendations are a consensus of their views.

2906 Nuclear Energy

Refer also to citation(s) 2739, 3035, 3457

3484 (INIS-mf–13369) **Speaking of nuclear energy: Highlights of proceedings from IAEA Public Information Regional Seminars.** Gillen, V.A. (ed.). International Atomic Energy Agency, Vienna (Austria). Div. of Public Information. Aut 1992 103p. Order Number DE93607987. Source: OSTI; NTIS (US Sales Only); INIS.

At the 1989 International Atomic Energy Agency (IAEA) General Conference, the Japanese Government pledged an extra-budgetary contribution for a three-year enhanced public information programme. On this basis the programme was developed centering on a series of two-day regional media seminars. It was determined that these seminars were to be informative and educational, and provide balanced, honest background material on the subject of nuclear energy. The speakers chosen were a mix of IAEA and outside experts from around the world. About 500 participants from 20 countries took part over the initial three years of the programme. This document contains a selection of speeches and topics that, is believed, captured the essence of the information presented during the regional seminars.

3485 (INIS-mf–13369, pp. 3-11) **Public attitudes and nuclear power: The question of nuclear power. (Cairo Egypt 3-4 March 1992).** Scott, R. (International Atomic Energy Agency, Vienna (Austria). Div. of Public Information). International Atomic Energy Agency, Vienna (Austria). Div. of Public Information. Aut 1992. 103p. In *Speaking of nuclear energy: Highlights of proceedings from IAEA Public Information Regional Seminars.* Order Number DE93607987. Source: OSTI; NTIS (US Sales Only); INIS.

Public attitudes evolution towards nuclear power in the light of the growing environmental concerns, and increasing demands for energy for growing economies, is reviewed.

3486 (INIS-mf–13369, pp. 13-23) **Energy, economics, environment and nuclear power. (Bombay, India 18 December 1989).** Blix, H. (International Atomic Energy Agency, Vienna (Austria)). International Atomic Energy Agency, Vienna (Austria). Div. of Public Information. Aut 1992. 103p. In *Speaking of nuclear energy: Highlights of proceedings from IAEA Public Information Regional Seminars.* Order Number DE93607987. Source: OSTI; NTIS (US Sales Only); INIS.

Having analysed the world situation with electricity consumption and different energy sources, including fossil fuel, renewable energy sources and nuclear power, to meet growing power demand, as well as aspects of environmental impacts, nuclear safety, nuclear waste management, non-proliferation regime, the author concludes that since environmental concerns are likely to make expansion of fossil fuel based power more and more questionable, and since there are simply no other options visible to generate the power that our energy-hungry world demands, the nuclear option is indispensable.

3487 (INIS-mf–13369, pp. 25-32) **Applications of nuclear science and technology. (Bangkok, Thailand 14-15 November 1991).** Collins, R.E. (Australian Nuclear Science and Technology Organisation, Lucas Heights (Australia)). International Atomic Energy Agency, Vienna (Austria). Div. of Public Information. Aut 1992. 103p. In *Speaking of nuclear energy: Highlights of proceedings from IAEA Public Information Regional Seminars.* Order Number DE93607987. Source: OSTI; NTIS (US Sales Only); INIS.

Non-power applications of nuclear technology in medicine, agriculture and industry, as well as spin-offs from nuclear power technology, which are essentially unknown by the general public, are discussed.

3488 (INIS-mf–13369, pp. 33-39) **Radiation and health: Some facts about radiation. (Bangkok, Thailand 14-15 November 1991).** Wahlstroem, B. (Loviisa Nuclear Power Plant, Loviisa (Finland)). International Atomic Energy Agency, Vienna (Austria). Div. of Public Information. Aut 1992. 103p. In *Speaking of nuclear energy: Highlights of proceedings from IAEA Public Information Regional Seminars.* Order Number DE93607987. Source: OSTI; NTIS (US Sales Only); INIS.

In a popular form concepts of radioactivity, decay, decay rate, ionizing radiation, and radiation health effects are described.

3489 (INIS-mf–13369, pp. 41-43) **Nuclear techniques for environmental conservation. (Bangkok, Thailand 15 November 1991).** Machi, S. (International Atomic Energy Agency, Vienna (Austria). Dept. of Research and Isotopes). International Atomic Energy Agency, Vienna (Austria). Div. of Public Information. Aut 1992. 103p. In *Speaking of nuclear energy: Highlights of proceedings from IAEA Public Information Regional Seminars.* Order Number DE93607987. Source: OSTI; NTIS (US Sales Only); INIS.

It is reported that the IAEA is promoting applications of nuclear techniques in the fields of industry, agriculture and medicine in cooperation with Member countries. In all fields of their application, nuclear techniques contribute to a reduction of harmful environmental impacts. The article is concerned with the application of various nuclear techniques other than power generation in connection with environmental conservation.

3490 (INIS-mf–13369, pp. 45-54) **Nuclear applications in food and agriculture. (Canberra, Australia 27-28 August 1990).** Dargie, J. (International Atomic Energy Agency, Vienna (Austria). Animal Production and Health Section). International Atomic Energy Agency, Vienna (Austria). Div. of Public Information. Aut 1992. 103p. In *Speaking of nuclear energy: Highlights of proceedings from IAEA Public Information Regional Seminars.* Order Number DE93607987. Source: OSTI; NTIS (US Sales Only); INIS.

A steady expansion in the incorporation of nuclear methods into agricultural research and development programmes, often with the assistance of the IAEA and FAO, is discussed.

3491 (INIS-mf–13369, pp. 73-81) **Nuclear safety: What is it, what does it involve? (Aomori, Japan 25-26 October 1990).** Carnino, A. (International Atomic Energy Agency, Vienna (Austria). Div. of Nuclear Safety). International Atomic Energy Agency, Vienna (Austria). Div. of Public Information. Aut 1992. 103p. In *Speaking of nuclear energy: Highlights of proceedings from IAEA Public Information Regional Seminars.* Order Number DE93607987. Source: OSTI; NTIS (US Sales Only); INIS.

Safety aspects of nuclear power plants, including design, operation, organization and management stages, are discussed.

3492 (INIS-mf–13369, pp. 83-89) **The radiological consequences of the Chernobyl accident. (Budapest, Hungary 29-30 May 1991).** Steinhaeusler, F. (Salzburg Univ. (Austria). Inst. fuer Allgemeine Biologie, Biochemie und Biophysik). International Atomic Energy Agency, Vienna (Austria). Div. of Public Information. Aut 1992. 103p. In *Speaking of nuclear energy: Highlights of proceedings from IAEA Public Information Regional Seminars.* Order Number DE93607987. Source: OSTI; NTIS (US Sales Only); INIS.

In 1990, upon request by the former USSR Government, a multinational team was formed to assess the radiological situation in the three affected Republics within the framework of the International Chernobyl Project (ICP). In May 1991, the findings of the project were presented in the form of a technical report to the international scientific community. The main results of this report are discussed in the article.

3493 (INIS-mf–13369, pp. 91-97) **The fuel cycle and nuclear waste management. (Canberra, Australia 27-28 August 1990).** McKinley, I.G. (Nationale Genossenschaft fuer die Lagerung Radioaktiver Abfaelle (NAGRA), Baden (Switzerland)). International Atomic Energy Agency, Vienna (Austria). Div. of Public Information. Aut 1992. 103p. In *Speaking of nuclear energy: Highlights of proceedings from IAEA Public Information Regional Seminars.* Order Number DE93607987. Source: OSTI; NTIS (US Sales Only); INIS.

The article discusses properties of radioactive wastes, produced at different phases of nuclear fuel cycle, their treatment and final disposal.

3494 (INIS-mf–13369, pp. 99-103) **The fuel cycle and plutonium as a reactor fuel. (Aomori, Japan 25-26 October 1990).** Bramman, J.I. (UKAEA International Relations (United Kingdom)). International Atomic Energy Agency, Vienna (Austria). Div. of Public Information. Aut 1992. 103p. In *Speaking of nuclear energy: Highlights of proceedings from IAEA Public Information Regional Seminars.* Order Number DE93607987. Source: OSTI; NTIS (US Sales Only); INIS.

Advantages of using plutonium, obtained by reprocessing the spent fuel, as nuclear fuel in thermal and fast breeder reactors are discussed.

3495 (INIS-mf–13369, pp. 65-72) **Nuclear proliferation and IAEA safeguards: The situation. (Canberra, Australia 27-28 August 1990).** Thorne, L. (International Atomic Energy Agency, Vienna (Austria). Dept. of Safeguards). International Atomic Energy Agency, Vienna (Austria). Div. of Public Information. Aut 1992. 103p. In *Speaking of nuclear energy: Highlights of proceedings from IAEA Public Information Regional Seminars.* Order Number DE93607987. Source: OSTI; NTIS (US Sales Only); INIS.

The article discusses the role and goals of non-proliferation regime and IAEA safeguards and reviews the IAEA activities in these fields.

3496 (KFK–5030) **Annual report 1991 of the Central Safety Department.** Koelzer, W. (comp.). Kernforschungszentrum Karlsruhe GmbH (Germany). Hauptabteilung Sicherheit. Apr 1992. 203p. (In German). Order Number DE93728984. Source: OSTI; NTIS (US Sales Only); INIS.

The Central Safety Department is responsible for handling all problems of radiation protection, safety and security of the institutes and departments of the Karlsruhe Nuclear Research Center, for waste water activity measurements and environmental monitoring of the whole area of the Center, and for research and development work mainly focusing on nuclear safety and radiation protection measures. The research and development work concentrates on the following aspects: Physical and chemical behavior of trace elements in the environment, behavior of tritium in the air/plant/soil system, biophysics of multicellular systems, improvement in radiation protection measurement and personnel dosimetry. This report gives details of the different duties, indicates the results of 1989 routine tasks and reports about results of investigations and developments of the working groups of the Department. The reader is referred to the English translation of the Table of Contents and of Chapter 1 describing the duties and organization of the Central Safety Department. (orig.).

2910 Conservation

3497 (DOE/AD–0034P) **FY 1991: Annual report on in-house energy management.** USDOE Office of Administration and Management, Washington, DC (United States). Office of Organization, Resources and Facilities Management. Oct 1992. 83p. Sponsored by USDOE, Washington, DC (United States). Order Number DE93003360. Source: OSTI; NTIS; GPO Dep.

The Department manages, measures, and reports energy consumption in three categories. The two major categories are buildings energy and metered process energy. The third, smaller category is vehicles and equipment. This Annual Report addresses program activities during FY 1991, summarizes total program achievements, and evaluates progress toward the achievement of DOE efficiency and energy reduction goals as outlined in the Ten-Year Plan, and the Executive Order 12759, "Federal Energy Management," of April 17, 1991.

3498 (ECN-C–92-019) **Current efficiency of Total Energy (TE) and Combined Heat and Power (CHP) systems.** Bais, J.M.; Beeldman, M.; Roemer, J.C. Netherlands Energy Research Foundation (ECN), Petten (Netherlands). Jun 1992. 63p. (In Dutch). Project ECN 7087. Order Number DE92557249. Source: OSTI; NTIS (US Sales Only).

For the subsidy applications within the framework of the Subsidy Regulation Energy Conservation and Renewable Energy (SES in Dutch) for 1992 more money is needed than is available for 1992. Therefore the Directorate-General for Energy of the Dutch Ministry of Economic Affairs authorized ESC-Energy studies of the Netherlands Energy Research Foundation to calculate the efficiencies of TE (Total Energy)- and CHP (Combined Heat and Power)-capacities for 1992. Next to the use of investment data, actualized within the framework of the study Energy Levies and Efficiency, 1992 energy prices were used. Also the conditions, under which TE- and CHP-systems can penetrate the market on their own,

have been investigated. Calculations have been made and presented of (1) efficiencies of TE- and CHP-capacities in 1992 for which use has been made of investment amounts from the long-term energy studies of ESC; (2) efficiencies of TE-capacities for which use has been made of investment amounts, as mentioned on the subsidy application forms; (3) efficiencies of TE- and CHP-capacities in 1992 with an adjusted price for electricity and an unaltered natural gas price with two variants; and (4) efficiencies of TE- and CHP-capacities for 1992 with an adjusted natural gas price and an unaltered price for electricity. An overall conclusion is that subsidized TE- and CHP-capacities show positive efficiencies for the current investments, fuel prices and electricity prices, except for the sector houses and homes for the elderly people. It can be justified to conclude that there is hardly any risk for the public utilities to implement TE- and CHP-capacities. 7 figs., 13 tabs., 14 apps., 12 refs.

3499 (NYSERDA–93001449) **New York State Energy Research and Development Authority annual report, 1991–1992.** New York State Energy Research and Development Authority, Albany, NY (United States). [1992]. 40p. Sponsored by New York State Energy Research and Development Authority, Albany, NY (United States). Source: OSTI; New York State Energy Research and Development Authority, Two Rockefeller Plaza, Albany, NY 12223; INIS.

To meet its energy and environmental goals, the Energy Authority faces a number of challenges affecting New York State's citizens. These include: Managing a nationally recognized energy research program of more than 250 ongoing projects located throughout the State that, through cutting-edge, energy-efficient technologies, identifies alternative energy sources; Participating in the joint Federal/State cleanup of a former nuclear fuel reprocessing plant at West Valley, an effort that will cost more than a billion dollars; Cleanup of the Malta Rocket Fuel Area Superfund site and maintenance of the shut-down State Low Level Radioactive Waste Disposal Area at West Valley; Issuing innovative tax-exempt bonds to finance utility projects, with $4.3 billion currently issued saving New York State citizens more than $4 billion; and Designing, building and operating a new low-level radioactive waste disposal facility for the State. In addition to these broad-based programs, the Energy Authority cosponsors the Student Energy Research Competition, a yearly science competition for high school students. Now in its eleventh year, the Competition continues to challenge students to explore solutions to meet our energy needs. This year, some 600 project proposals were submitted by 1217 students representing 85 schools throughout New York State. The Competition is cosponsored by the State Energy Office. Energy Authority programs help to ensure that, as we protect environmental values and promote economic growth, New York State has secure and economical future supplies of energy.

3500 (ORNL/TM–12182) **A prefeasibility study of energy resource options in Hainan, China.** Hill, L.J. (Oak Ridge National Lab., TN (United States)); Russell, M.; Barron, W.F.; LaRocco, P.; Shen, Z. Oak Ridge National Lab., TN (United States). Oct 1992. 46p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. Order Number DE93003675. Source: OSTI; NTIS; GPO Dep.

This study identifies a strategy that (1) provides future energy services for Hainan in the least environmentally degrading way, (2) eliminates the need to build significant amounts of new fossil-fueled, electric generating capacity, saving capital to invest in other development projects, (3) lowers the cost that Hainan households and businesses will pay to light their homes and run their industries, (4) reduces the future coal import bill, and (5) improves the prospects for export industries. implementing this strategy will promote economic development and growth in Hainan, improve the standard of living, and preserve to the greatest extent possible Hainan's rich environmental resource base, a key requirement for its tourist industry. The focus of this strategy is to adapt proven policies and techniques for producing and using energy more efficiently to existing conditions in Hainan. This Report applies the principles of integrated resource planning (IRP) and the experiences in other countries to outline a strategy for the Province. The experience is that fuel consumption can be reduced without lessening the ability of consumers, industry, and the government to obtain the energy services that higher use of fuel would otherwise bring. Further, those energy services can be provided with less capital investment than would be necessary if traditional practices were followed. Both of these results have obvious and important development and environmental benefits. In short, consumers have more money available to buy other things; production costs are lowered, improving the ability of firms to compete in international markets; and more capital is available to invest in new machinery and equipment that produces goods and services to use in Hainan or to export to other countries.

2920 Supply, Demand, and Forecasting

Refer also to citation(s) 3457, 3477

3501 (DOE/EIA–0202(92/4Q)) **Short-term energy outlook: Quarterly projections, fourth quarter 1992.** USDOE Energy Information Administration, Washington, DC (United States). Office of Energy Markets and End Use. 6 Nov 1992. 37p. Sponsored by USDOE, Washington, DC (United States). Order Number DE93003219. Source: OSTI; NTIS; GPO; GPO Dep.

The Energy Information Administration (EIA) prepares quarterly, short-term energy supply, demand, and price projections for publication in February, May, August, and November in the Short-Term Energy Outlook (Outlook). An annual supplement analyzes the performance of previous forecasts, compares recent cases with those of other forecasting services, and discusses current topics related to the short-term energy markets. The principal users of the Outlook are managers and energy analysts in private industry and government. The forecast period for this issue of the Outlook extends from the fourth quarter of 1992 through the fourth quarter of 1993. Values for the third quarter of 1992, however, are preliminary EIA estimates (for example, some monthly values for petroleum supply and disposition are derived in part from weekly data reported in the Weekly Petroleum Status Report) or are calculated from model simulations using the latest exogenous information available (for example, electricity sales and generation are simulated using actual weather data). The historical energy data are EIA, data published in the Monthly Energy Review, Petroleum Supply Monthly, and other EIA publications. Minor discrepancies between the data in these publications and the historical data in this Outlook are due to independent rounding. The cases are produced using the Short-Term Integrated Forecasting System (STIFS). The STIFS model is driven principally by three sets of assumptions or inputs: estimates of key macroeconomic variables, world oil price assumptions, and assumptions about the severity of weather. Macroeconomic estimates are produced by DRI/McGraw-Hill but are adjusted by EIA to reflect EIA assumptions about the world price of crude oil, energy product prices, and other assumptions which may affect the macroeconomic outlook. The EIA model is available on computer tape from the National Technical Information Service.

3502 (PNL–8290) **Expected benefits of federally-funded thermal energy storage research.** Spanner, G.E.; Daellenbach, K.K.; Hughes, K.R.; Brown, D.R.; Drost, M.K. Pacific Northwest Lab., Richland, WA (United States). Sep 1992. 91p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE93003139. Source: OSTI; NTIS; GPO Dep.

Pacific Northwest Laboratory (PNL) conducted this study for the Office of Advanced Utility Concepts of the US Department of Energy (DOE). The objective of this study was to develop a series of graphs that depict the long-term benefits of continuing DOE's thermal energy storage (TES) research program in four sectors: building heating, building cooling, utility power production, and transportation. The study was conducted in three steps- The first step was to assess the maximum possible benefits technically achievable in each sector. In some sectors, the maximum benefit was determined by a "supply side" limitation, and in other sectors, the maximum benefit is determined by a "demand side" limitation. The second step was to apply economic cost and diffusion models to estimate the benefits that are likely to be achieved by TES

under two scenarios: (1) with continuing DOE funding of TES research, and (2) without continued funding. The models all cover the 20-year period from 1990 to 2010. The third step was to prepare graphs that show the maximum technical benefits achievable, the estimated benefits with TES research funding, and the estimated benefits in the absence of TES research funding. The benefits of federally-funded TES research are largely in four areas: displacement of primary energy, displacement of oil and natural gas, reduction in peak electric loads, and emissions reductions.

2930 Policy, Legislation, and Regulation

Refer also to citation(s) 3471

2940 Fossil Fuels

Refer also to citation(s) 2596, 2608, 2609, 2610, 2611, 2613, 2621, 2625, 3457, 3478, 3501, 3506

3503 (DOE/EIA–0035(92/09)) **Monthly energy review, September 1992.** USDOE Energy Information Administration, Washington, DC (United States). Office of Energy Markets and End Use. 24 Sep 1992. 168p. Sponsored by USDOE, Washington, DC (United States). Order Number DE93000625. Source: OSTI; NTIS; GPO; GPO Dep.

This report presents data on the following various energy topics and sources: Energy overview; energy consumption; petroleum; natural gas; oil and gas resource development; coal; electricity; nuclear energy; energy prices; and international energy.

3504 (ETDE-mf–93728807) **The oil market at the beginning of the nineties.** Wirtschaftswissenschaftliche Diskussionsbeitraege. Volkswirtschaftliche Reihe Institut fuer Volkswirtschaftslehre, Universitaet Oldenburg. Hensing, I.; Stroebele, W. Oldenburg Univ. (Germany). Inst. fuer Volkswirtschaftslehre (VWL). Sep 1991 19p. (In German). Order Number DE93728807. Source: OSTI; NTIS (US Sales Only).

As energy carriers or raw materials, mineral oil and its products hold a key role in modern industrialized societies. Estimates of the volume in terms of value of international oil markets rate it to be more than 300 billions US-$ for 1988 alone. During the Iraqi occupation of Kuwait and its reconquest, the multinational oil corporations, in particular, were criticized by the general public for calculating their prices far off from any demand-and-supply conditions. Underlying this criticism is the idea out-date since 1973 about the mode of function and structure of international oil markets. More intensive competition both in supply and demand have caused the trade to acquire, by now, the traits of international financial markets. The authors highlight some aspects of this development, espec. forward contracts in oil trade. Special emphasis is placed on the determinants of oil price formation. Theoretical principles are supplied if found to necessary round of the discussion. (orig.).

2960 Electric Power

Refer also to citation(s) 2596, 3457, 3478, 3501, 3503, 3551, 4790

3505 (ETDE-IT–92-94) **Power distribution network load predicting by interpolation and extrapolation of power consumption statistical data: Statistical model application.** Fracassi, G.; Grattieri, W.; Insinga, F.; Malafarina, L.; Mazzoni, M. Ente Nazionale per l'Energia Elettrica, Milan (Italy). Centro di Ricerca Elettrica. 1991. 21p. (In Italian). (CONF-9112143–2: Alimentazione elettrica delle grandi aree urbane, Milan (Italy), 10-11 Dec 1991). Order Number DE93729461. Source: OSTI; NTIS (US Sales Only).

This paper presents a procedure developed by ENEL (Italian National Electricity Board) for the automatic prediction of territorial loads in its national distribution system. This procedure is based on an extrapolation method incorporating annual power consumption historical series, disaggregated by consuming sector, divided by voltage level, and further subdivided by zone. An analysis is made of the method used to transform the annual power consumption figures into suitable data to be input into distribution network planning studies. Attention is also focussed on the method for assigning determined loads to each particular network node. The paper indicates how forecasted power consumption figures are substituted by actual figures as they become available so as to improve prediction accuracy. A discussion is made of the 'final use' technique for the planning of urban network expansions. Data representing the evolution of power consumption in major Italian cities is used to give an indication of national trends.

2980 Consumption and Utilization

Refer also to citation(s) 2596, 3457, 3500

3506 (ANL/ESD/TM–34) **The impact of rising energy prices on household energy consumption and expenditure patterns: The Persian Gulf crisis as a case example.** Henderson, L.J. (Baltimore Univ., MD (United States)); Poyer, D.A.; Teotia, A.P.S. Argonne National Lab., IL (United States). Energy Systems Div. Sep 1992. 22p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-31109-ENG-38. Order Number DE93003331. Source: OSTI; NTIS; GPO Dep.

The Iraqi invasion of Kuwait and the subsequent war between Iraq and an international alliance led by the United States triggered immediate increases in world oil prices. Increases in world petroleum prices and in US petroleum imports resulted in higher petroleum prices for US customers. In this report, the effects of the Persian Gulf War and its aftermath are used to demonstrate the potential impacts of petroleum price changes on majority, black, and Hispanic households, as well as on poor and nonpoor households. The analysis is done by using the Minority Energy Assessment Model developed by Argonne National Laboratory for the US Department of Energy (DOE). The differential impacts of these price increases and fluctuations on poor and minority households raise significant issues for a variety of government agencies, including DOE. Although the Persian Gulf crisis is now over and world oil prices have returned to their prewar levels, the differential impacts of rising energy prices on poor and minority households as a result of any future crisis in the world oil market remains a significant long-term issue.

2990 Unconventional Sources and Power Generation

Refer also to citation(s) 2861, 2907

3507 (INIS-mf–13362, pp. 075-080) **Economic aspects of renewable energy technologies installation in the CSFR.** Sejak, J. (Ceskoslovenska Akademie Ved, Prague (Czechoslovakia)). Czechoslovak Solar Energy (Czechoslovakia); Ceske Vysoke Uceni Technicke, Prague (Czechoslovakia). 1991. 121p. (CONF-9107237–: 1991 renewable energy sources international conference, Prague (Czechoslovakia), 1-4 Jul 1991). In *Renewable energy sources '91. Part 2: Wind energy, biogas, small hydro.* Order Number DE93605634. Source: OSTI; NTIS (US Sales Only); INIS.

The economic and environmental heritage of the totalitarian system in Czechoslovakia and comparative economic conditions for the implementation of renewable energy technologies are dealt with. Several techniques of project evaluation are analyzed, and an application is presented to a concentrated solar collector. (author) 1 tab., 2 refs.

3508 (INIS-mf–13362, pp. 080-085) **Economic impulses to the implementation of alternative energy sources.** Petruzela, L. (Ceskoslovenska Akademie Ved, Prague (Czechoslovakia)). Czechoslovak Solar Energy (Czechoslovakia); Ceske Vysoke Uceni Technicke, Prague (Czechoslovakia). 1991. 121p. (In Czech). (CONF-9107237–: 1991 renewable energy sources international conference, Prague (Czechoslovakia), 1-4 Jul 1991). In *Renewable energy sources '91. Part 2: Wind energy, biogas, small hydro.* Order Number DE93605634. Source: OSTI; NTIS (US Sales Only); INIS.

The factors are considered of macroeconomic regulation and microeconomic incentives of the implementation of alternative energy sources in condition of prevailing utilization of conventional energy

sources. The analysis concludes that both state regulation and microeconomic incentives shift a time horizon of effective implementation of alternative sources nearer to the present. (author) 6 figs.

30 DIRECT ENERGY CONVERSION

3001 MHD Generators

Refer also to citation(s) 2494

3509 (DOE/PC/88928–T17) **Corrosion and arc erosion in MHD channels: Final report.** Rosa, R.J. (Montana State Univ., Bozeman, MT (United States). Dept. of Mechanical Engineering); Pollina, R.J. Montana State Univ., Bozeman, MT (United States). Dept. of Mechanical Engineering. Aug 1992. 61p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG22-88PC88928. Order Number DE93001721. Source: OSTI; NTIS; GPO Dep.

The problems connected with gas side corrosion for the design of the IA4 (POC) channel hardware are explored and results of gas side wear rate tests in the Textron Mark VII facility are presented. It is shown that the proposed designs meet a 2000 hour lifetime criterion based upon these materials tests. Improvement in cathode lifetime is demonstrated with lower voltage intercathode gaps. The corrosion of these materials is discussed and it is shown how lifetimes are dependent upon gap voltage and average metal temperature. The importance of uniformity of slagging to the durability of the anode wall is demonstrated. The wear mechanism of the anodes in the MHD channel is analyzed. In addition to gas-side corrosion, the results of specific water corrosion tests of sidewall materials are discussed. All of the tests reported here were carried out to confirm the gas-side performance and the manufacturability of anode and sidewall designs and to address questions posed about the durability of tungsten-copper on the waterside. the results of water corrosion tests of the tungsten copper alloy sidewall material are presented to show that with proper control of waterside pH and, if necessary, dissolved oxygen, one can obtain reliable performance with no degradation of heat transfer with this material. The final choice of materials was determined primarily by the outcome of these tests and also by the question of the manufacturability of the prospective designs.

3003 Thermoelectric Generators

3510 (WHC-SA–1594) **A shielded storage and processing facility for radioisotope thermoelectric generator heat source production.** Sherrell, D.L. Westinghouse Hanford Co., Richland, WA (United States). Jun 1992. 8p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-87RL10930. (CONF-930103–10: 10. symposium on space nuclear power and propulsion, Albuquerque, NM (United States), 10-14 Jan 1993). Order Number DE92040417. Source: OSTI; NTIS; GPO Dep.

This report discusses a shielded storage rack which has been installed as part of the Radioisotope Power Systems Facility (RPSF) at the US Department of Energy's (DOE) Hanford Site in Washington State. The RPSF is designed to replace an existing facility at DOE's Mound Site near Dayton, Ohio, where General Purpose Heat Source (GPHS) modules are currently assembled and installed into Radioisotope Thermoelectric Generators (RTG). The overall design goal of the RPSF is to increase annual production throughput, while at the same time reducing annual radiation exposure to personnel. The shield rack design successfully achieved this goal for the Module Reduction and Monitoring Facility (MRMF), which process and stores assembled GPHS modules, prior to their installation into RTGS. The shield rack design is simple and effective, with the result that background radiation levels within Hanford's MRMF room are calculated at just over three percent of those typically experienced during operation of the existing MRMF at Mound, despite the fact that Hanford's calculations assume five times the GPHS inventory of that assumed for Mound.

3005 Fuel Cells

3511 (DOE/ET/17089–3120) **Design, fabrication and testing of a solid oxide fuel cell stack for a 25 kW to 200 kW generator: Volume 1, Executive summary; Volume 2, Final report: March 1986–December 1990.** Westinghouse Electric Corp., Pittsburgh, PA (United States). Science and Technology Center. Dec 1990. 210p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC21-80ET17089. Order Number DE92012462. Source: OSTI; NTIS; GPO Dep.

The effort reported herein was carried out over the period from March 1986 through December 1990, modifications (A030 through A056) to Contract DE-AC21-17089 (prior number: DE-AC02-17089), The High Temperature Solid Oxide Electrolyte Fuel Cell Power Generation System. Prior effort under the contract covered the period since June 1980 and culminated in placing on test a 5 kilowatt (kW) generator. Intermediate steps included testing of many materials and single cells (~15 watts), a three cell bundle (~45 watts) that was operated successfully for nearly 9000 hours, and a 24 cell (~400 watts) submodule that was operated successfully for more than 2000 hours. The technical effort in the current modification is organized under three technical tasks that have objectives as follows: (1) To define a reference design, subsystem design, and component requirements for a tubular solid oxide fuel cell plant with the greatest potential to be commercialized; (2) To develop and verify cell performance, which satisfies the component requirements; and, (3) To develop and verify stack performance, which satisfies the component requirements.

3512 (DOE/MC/24221–3130) **Advanced water-cooled phosphoric acid fuel cell development: Final report.** International Fuel Cells Corp., South Windsor, CT (United States). Sep 1992. 86p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC21-88MC24221. (FCR–12321A). Order Number DE93000215. Source: OSTI; NTIS; GPO Dep.

This program was conducted to improve the performance and minimize the cost of existing water-cooled phosphoric acid fuel cell stacks for electric utility and on-site applications. The goals for the electric utility stack technology were a power density of at least 175 watts per square foot over a 40,000-hour useful life and a projected one-of-a-kind, full-scale manufactured cost of less than $400 per kilowatt. The program adapted the existing on-site Configuration-B cell design to electric utility operating conditions and introduced additional new design features. Task 1 consisted of the conceptual design of a full-scale electric utility cell stack that meets program objectives. The conceptual design was updated to incorporate the results of material and process developments in Tasks 2 and 3, as well as results of stack tests conducted in Task 6. Tasks 2 and 3 developed the materials and processes required to fabricate the components that meet the program objectives. The design of the small area and 10-ft^2 stacks was conducted in Task 4. Fabrication and assembly of the short stacks were conducted in Task 5 and subsequent tests were conducted in Task 6. The management and reporting functions of Task 7 provided DOE/METC with program visibility through required documentation and program reviews. This report describes the cell design and development effort that was conducted to demonstrate, by subscale stack test, the technical achievements made toward the above program objectives.

3513 (DOE/MC/24221–3143) **Advanced Water-Cooled Phosphoric Acid Fuel Cell Development: Quarterly technical progress report No. 47, January–March, 1992.** International Fuel Cells Corp., South Windsor, CT (United States). May 1992. 14p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC21-88MC24221. (FCR–12285). Order Number DE93003358. Source: OSTI; NTIS; GPO Dep.

This program is being conducted to improve the performance and minimize the cost of water cooled, electric utility phosphoric acid fuel cell stacks. The program adapts the existing on-site Configuration B cell design to electric utility operating conditions and introduces additional new design features. Task 1 consists of the conceptual design of a full-scale electric utility cell stack that meets program objectives. Tasks 2 and 3 develop the materials and processes requested to fabricate the components that meet the program objective. The design of the small area and two 10-ft^2 short stacks is conducted in Task 4. The conceptual design also is

updated to incorporate the results of material and process developments, as well as results of stack tests conducted in Task 6. Fabrication and assembly of the short stacks are conducted in Task 5 and subsequent tests are conducted in Task 6. The Contractor expects to enter into a contract with the Electric Power Research Institute (EPRI) to assemble and endurance test the second 10-ft^2 short stack. The management and reporting functions of Task 7 provide DOE/METC with program visibility through required documentation and program reviews. This report describes the cell design and development effort that is being conducted to demonstrate, by subscale stack test, the technical achievements made toward the above program objectives.

3514 (DOE/MC/27393–3125) **Simulated Coal-Gas-Fueled Molten Carbonate Fuel Cell Development Program: Final report.** International Fuel Cells Corp., South Windsor, CT (United States). Aug 1992. 203p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC21-91MC27393. (FCR–12328). Order Number DE93000205. Source: OSTI; NTIS; GPO Dep.

This final report summarizes the technical work performed under Department of Energy Contract DE-AC21-91MC27393, "Simulated Coal- Gas-Fueled Molten Carbonate Fuel Cell Development Program." This work consists of five major tasks and their respective subtasks as listed below. A brief description of each task is also provided. The Stack Design Requirements task focused on requirements and specification for designing, constructing, and testing a nominal 100-kilowatt integrated stack and on requirements for the balance-of-plant equipment to support a 1000-kilowatt integrated stack demonstrator. The Stack Design Preparation task focused on the mechanical design of a 100-kilowatt stack comprised of 8-ft^2 cells incorporating the new cell configuration and component technology improvements developed in the previous DOE MCFC contract. Electrode Casting focused on developing a faster drying solvent for use in the electrode tape casting process. Electrode Heat Treatment was directed at scaling up the laboratory continuous debinding process to a new full-size IFC debinding oven coupled to a continuous belt furnace that will both debind and sinter the electrodes in one continuous process train. Repeat Part Quality Assurance and Testing provided the appropriate effort to ensure consistent, high-quality, reproducible and comparable repeat parts.

3515 (DOE/METC/C–92/7026) **Welcome to METC.** Langan, W.T. Department of Energy, Morgantown, WV (United States). Morgantown Energy Technology Center. [1992]. 6p. Sponsored by USDOE, Washington, DC (United States). (CONF-920748–23: US Department of Energy contractors review meeting on fuel cells, Morgantown, WV (United States), 14-15 Jul 1992). Order Number DE93001377. Source: OSTI; NTIS; GPO Dep.

Welcome to the Department of Energy's Fourth Annual Fuel Cell Contractors Review Meeting. I am looking forward to your active participation in this important conference over the next 2 days. I am personally excited about this technology and its great potential to provide a real impact in response to our nation's future energy needs and competitiveness. We are pursuing six product systems at METC; fuel cells systems, gasification systems, combustion systems, advanced turbine systems, waste management systems, and fuel resources systems.

3516 (DOE/METC/C–93/7031) **Networking electrochemical membrane separation devices: Theory and application.** Wimer, J.G. (Department of Energy, Morgantown, WV (United States). Morgantown Energy Technology Center); Williams, M.C.; Archer, D.H.; Osterle, J.F. Department of Energy, Morgantown, WV (United States). Morgantown Energy Technology Center. [1992]. 10p. Sponsored by USDOE, Washington, DC (United States). (CONF-921104–6: American Institute of Chemical Engineers annual meeting, Miami, FL (United States), 1-6 Nov 1992). Order Number DE93001381. Source: OSTI; NTIS; GPO Dep.

Two of the most promising applications for electrochemical membranes are fuel cells and separation devices. In a fuel cell, fuel and oxidant flow on opposite sides of an ionically conductive membrane. An electrochemical potential is generated between electrodes which are mounted on either side of the membrane. Fuel cells take advantage of this electrochemical potential to generate electrical work. Conversely, electrochemical membrane separation devices (EMSDS) consume electrical energy as they remove selected species from a gas stream. When voltage is supplied between the electrodes on opposite sides of a separation membrane, ions carry the species to be removed from one side of the membrane to the other. Although these applications are quite different their general operation is based upon the same electrochemical principles. Consequently, electrochemical membranes which have been developed for fuel cells can easily be adapted for use in separation devices. Likewise, the concept of networking electrochemical membranes, which is currently being developed to boost the efficiency of molten carbonate fuel cell systems, can also e applied to EMSDS. Networks, which are more effective than individual nit operations, have been widely used in the process industries. In the context of this paper, networking is defined as ducting process streams such that they flow through electrochemical membrane devices in series.

3517 (ECN-C–92-030) **Manufacturing techniques for components of flat plate, solid oxide fuel cell (SOFC) reactors: First semi-annual progress report July 1991-December 1991.** Huijsmans, J.P.P. (Netherlands Energy Research Foundation, Petten (Netherlands)); Piro, G.; Greiner, H. Netherlands Energy Research Foundation (ECN), Petten (Netherlands). Jun 1992. 54p. Contract BREU-CT91-0423 (HSMU). Order Number DE92557251. Source: OSTI; NTIS (US Sales Only).

The activities of the Netherlands Energy Research Foundation (ECN), Enirecerche (Milan, Italy), and Siemens AG (Erlangen, Germany) concerning the cooperative title research project are described. This project is partly funded by the Committee of European Communities (CEC) within the framework of the BRITE/EURAM programme. The cooperative research programme aims at the development of new, reproducable manufacturing techniques for powders and components (electrodes, electrolytes, metallic bipolar plate) for upscaled, flat plate, solid oxide fuel cells (SOFC). For larger SOFC reactors (e.g. 1 kW) these components are needed in greater quantities and with enlarged dimensions. Enirecerche has prepared the first anode- and cathode powders according to a wet-chemical preparation technique. ECN upscaled the dimensions of sintered electrolytes to 10x10 cm^2 and has deposited anode- and cathode electrodes on sintered electrolytes by tape casting. Siemens has fabricated and qualified three groups of new metal alloys. Planning for the next contract period is given.

3518 (ECN-C–92-034) **Development of Solid Oxide Fuel Cell (SOFC): Third semi-annual progress report August 1991-January 1992.** Huijsmans, J.P.P.; Van Heuveln, F.H.; Van Berkel, F.P.F. Netherlands Energy Research Foundation (ECN), Petten (Netherlands). Jun 1992. 18p. Contract CEC JOUE-0048-C. Order Number DE92557252. Source: OSTI; NTIS (US Sales Only).

The Netherlands Energy Research Foundation (ECN) is carrying out the title cooperative research programme, sponsored by the Committee of the European Communities (CEC) JOULE programme. Partners in the programme are Siemens AG (Germany), ECN, Imperial College (UK), and GEC Alsthom (UK). ECN will develop and investigate materials manufacturing procedures and will test alternative cell concepts. Activities of ECN include electrode powder fabrication, development of ceramic components, development of metal separator plate, physico-chemical characterization, chemical interface problems between ceramic components, materials testing, and proof-of principle of 3 Watt (50x50 mm^2) and 10 Watt (100x100 mm^2) level SOFC's. 4 figs., 11 refs.

3519 (ECN-C–92-037) **Fabrication and evaluation of small (≈100W) SOFC (Solid Oxide Fuel Cell) reactors: Final report: Task 3.2. Preparation of ceramic bi-polar plates.** Huijsmans, J.P.P.; Van Tilborg, P.J. Netherlands Energy Research Foundation (ECN), Petten (Netherlands). Jun 1992. 16p. Contract CEC EN3E.0189.C(H);Project ECN 0505.31. Order Number DE92557272. Source: OSTI; NTIS (US Sales Only).

Bipolar plates of $LaCrO_3$ were made by tape casting and sintering. A comparison was made between Mg and Ca as a dopant species for $LaCrO_3$ powder, which was made by citrate pyrolysis. In the former case no uniform densification could be obtained, although extreme sintering conditions were applied (1750°C and P_{O2} $2\text{-}3*10^{-11}$). In the latter case porous (12-15% total porosity) or gas-tight bipolar plates of 56x56x0.5 mm^3 could be fabricated, depending on the sintering temperature. Small, porous plates of

Ca-doped $LaCrO_3$ could be made impermeable with ECVD (Electro-Chemical Vapor Deposition), by depositing $LaCrO_3$ in the pores, but Ca-migration occurred during ECVD operation. Larger plates (56x56x0.5 mm^3) of porous Ca-doped $LaCrO_3$ (single layer- or triple laminated plates) always cracked in the ECVD reactor, which, most probably, is due to a difference in coefficient of thermal expansion between the $LaCrO_3$ bipolar plate and the Al_2O_3 ECVD holder, in which the bipolar plate was cemented. The gas-tight plates of Ca-doped $LaCrO_3$ were fabricated by sintering in air at 1600°C. The resulting plates were stable under SOFC conditions, i.e. at high temperatures, under a strong oxygen partial pressure gradient. Direct gas-tight sintering makes the ECVD-step superfluous. 4 figs., 8 refs.

3520 **Membrane catalyst layer for fuel cells.** Wilson, M.S. To Dept. of Energy. 19 Feb 1991. USAA patent application 7-656,32. 20p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. Order Number DE93002001. Source: OSTI; NTIS; GPO Dep.

A gas reaction fuel cell incorporates a thin catalyst layer between a solid polymer electrolyte (SPE) membrane and a porous electrode backing. The catalyst layer is preferably less than about 10 μm in thickness with a carbon supported platinum catalyst loading less than about 0.35 $mgPt/cm^2$. The film is formed as an ink that is spread and cured on a film release blank. The cured film is then transferred to the SPE membrane and hot pressed into the surface to form a catalyst layer having a controlled thickness and catalyst distribution. The layer has adequate gas permeability so that cell performance is not affected and has a density and particle distribution effective to optimize proton access to the catalyst and electronic continuity for electron flow from the half-cell reaction occurring at the catalyst.

32 ENERGY CONSERVATION, CONSUMPTION, AND UTILIZATION

Refer also to citation(s) 3905

3521 (CONF-9210183–Vol.2) **Transportation alternatives 92: Alternative fueled vehicles: Proceedings: Volume 2.** Massachusetts Div. of Energy Resources, Boston, MA (United States). [1992]. 111p. Sponsored by USDOE, Washington, DC (United States). From Northeast Sustainable Energy Association meeting; Boston, MA (United States); 9-10 Oct 1992. Order Number DE93001500. Source: OSTI; NTIS; GPO Dep.

Transportation Alternatives 92 (alternative fueled vehicles) was held October 8–9, 1992 at the Massachusetts Division of Energy Resources, Boston, MA. The relevant papers have been entered individually.

3201 Buildings

Refer also to citation(s) 2578, 2579, 2580, 2581, 2582, 2812, 3449, 3497, 4424

3522 (BNL–47990) **A comprehensive yardstick for residential thermal distribution efficiency.** Modera, M.P. (Lawrence Berkeley Lab., CA (United States)); Andrews, J.; Kweller, E. Brookhaven National Lab., Upton, NY (United States). [1992]. 18p. Sponsored by USDOE, Washington, DC (United States); California Inst. for Energy Efficiency, Berkeley, CA (United States). DOE Contract AC02-76CH00016. (CONF-920828–20: American Council for an Energy-Efficient Economy (ACEEE) summer study on energy efficiency in buildings, Pacific Grove, CA (United States), 30 Aug - 5 sep 1992). Order Number DE93001976. Source: OSTI; NTIS; INIS; GPO Dep.

Thermal Energy Distribution (TED) systems provide the critical link between heating and cooling equipment and the conditioned area of buildings. TED systems have also been shown to have a large potential for efficiency improvement, partially in residences. This paper discusses the issues associated with characterizing the performance of TED systems in residential buildings. A possible framework for a universal figure of merit for residential TED systems that takes into account interactions between the TED system and the building envelope, interactions with the heating/cooling equipment, as well as the weather-dependence of TED efficiencies, is proposed. The proposed efficiency characterization framework incorporates the TED/envelope interactions that have been extensively studied in crawlspace and slab-on-grade houses over the past several years, as well as some of the findings of ASHRAE Special Project 43 (SP43), which focused on air distribution systems in basement houses. This framework is designed to allow for compatibility with existing equipment and envelope characterizations (e.g., Annual Fuel Use Efficiency (AFUE), Seasonal Energy Efficiency Ratio (SEER), Heating Seasonal Performance Factor (HSPF), Effective Leakage Area (ELA)), and to allow for comparison of forced-air, hydronic and refrigerant distribution systems, including the impacts of zoning. The proposed backbone for most of the supporting analyses required to develop a practical yardstick is a combined simulation model based upon DOE-2, COMIS (a multi-zone airflow network model) and a combined heat and mass transfer model for duct systems. Efficiency calculations made with this model for a typical attic duct system are included as an example. Two applications identified for this figure of merit are utility DSM programs and building energy codes.

3523 (CONF-921203–5) **A shape factor method for computing heating loads from building slab-on-grade foundations.** Rust, W.W.; Christian, J.E. Oak Ridge National Lab., TN (United States). 31 Aug 1992. 35p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. From Thermal performance of the exterior envelopes of buildings; Clearwater, FL (United States); 7-10 Dec 1992. Order Number DE92041251. Source: OSTI; NTIS; GPO Dep.

A shape factor method, designated the Z-shape factor, is presented which provides a simple, hand calculation technique of predicting daily, weekly, or seasonal heat loads due to the effects of slab-on-grade earth coupling. This semi-analytic method accommodates a wide range of time periods and local soil and weather conditions, and is limited to vertical insulation schemes. The unique feature of the Z-shape factor method is that it allows a user to input soil conductivity and several site-specific geometric parameters. This extends the usefulness of the general shape factor method available in the ASHRAE Handbook and other recent publications since more site-specific inputs can be utilized in the below-grade heat loss estimation. Predictions derived from the shape factor method are compared to other simplified prediction procedures and to field data. The field data collected from an earth-coupling experiment being conducted at a laboratory are used to check the predicted heat loss by the Z-shape factor method from both an insulated and uninsulated slab-on-grade. Results are within 10% of the alternative computations and of the field data, which suggests the procedure is 'suitable for most annual heat and peak heating load calculations for slab-on-grade structures.

3524 (CONF-930118–1) **Thermal performance of clean horizontal radiant barriers under winter conditions: Laboratory measurements and mathematical modeling.** Wilkes, K.E.; Childs, P.W. Oak Ridge National Lab., TN (United States). [1992]. 32p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. From Winter meeting of the American Society of Heating, Refrigeration and Air Conditioning Engineers; Chicago, IL (United States); 23-27 Jan 1993. Order Number DE92017132. Source: OSTI; NTIS; GPO Dep.

Several field experiments have been performed on attic radiant barriers under winter conditions; however, most of them have been confined to the fairly mild climates of Florida, Oklahoma, and Tennessee. Only one field experiment in a very cold climate (Canada) has been performed. In addition, no previous laboratory experiments under winter conditions have been performed on an attic both with and without a radiant barrier. This paper presents the results of laboratory measurements of the thermal performance of clean horizontal radiant barriers in a simulated residential attic module under nighttime or low solar gain daytime winter conditions. Comparing tests under the same conditions with and without a radiant barrier shows that the addition of a clean horizontal radiant barrier to insulation at the R-22 to R-25 level decreases the ceiling heat flow by 6 to 8%. The experimental results were found to be in

very good agreement with predictions made with a mathematical model for the thermal performance of attics.

3525 (DOE/CE/21002–T1) **Monitoring conservative retrofits in single family buildings: Final technical report.** Richardson, C.S. Florida Solar Energy Center, Cape Canaveral, FL (United States). 6 Dec 1992. 156p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG01-90CE21002. (FSEC-CR–566-92). Order Number DE93003891. Source: OSTI; NTIS; INIS; GPO Dep.

This study has provided detailed before-and-after information on the ambient and comfort conditions in nine single family buildings, and on the energy consumption of those buildings, for one or more energy conservation retrofits. The data were recorded in such a manner that as well as being able to determine the savings from the retrofits and the influence these retrofits have on the comfort conditions of the residence, the effects of the retrofits on time-of-day usage are also determinable. The following are included in appendices: a table of participant's names, site addresses and retrofit; significant dates and appropriate comments; a day of data and an annotated data set; pre-retrofit and post-retrofit audit data sheets; and usage history.

3526 (IBP-GB–70/91) **Component-integrated heating system and building services for future construction concepts (hybrid heating systems) - integration of plant and solar components. Interim report.** Truemper, H. (Dortmund Univ. (Germany). Lehrstuhl fuer Technische Gebaeudeausruestung). Fraunhofer-Institut fuer Bauphysik, Stuttgart (Germany); Bundesministerium fuer Forschung und Technologie, Bonn (Germany). Mar 1991. 27p. (In German). Contract BMFT 0338928A. Order Number DE93728730. Source: OSTI; NTIS (US Sales Only).

Reduction of transmission heat losses followed by a reduction of ventilation heat losses by controlled ventilation with heat recovery are prerequisites for low-energy houses. Further components such as underground pipe heat exchangers and air collectors help additionally to save energy. Within the framework of the project warm air flow through internal building units of hybrid heating systems has been investigated. The aim was to use the cavities contained in building units for warm air flow and the component itself as storage system. There are different possibilities for the use of intermediate walls as storage system. The control system of such a plant consists of a storage component, the ventilation system and a supplementary heating system. With some examples such control systems with different components and circuit configurations are explained. (BWI) With 12 figs.

3527 (IBP-GB–71/91) **Component-integrated heating system and building services for future construction concepts (hybrid heating systems) - constructional aspects. Interim report.** Bertsch, K.; Schiel, W.; Scholze, G. Fraunhofer-Institut fuer Bauphysik, Stuttgart (Germany); Bundesministerium fuer Forschung und Technologie, Bonn (Germany). 28 Apr 1991. 21p. (In German). Contract BMFT 0338928A. Order Number DE93728731. Source: OSTI; NTIS (US Sales Only).

Multi-purpose use of building components with cavities for hybrid heating systems is technically and structurally realizable. The cavities serve as air channels and the component mass as heat storage system. Ceilings and walls are suited for this purpose. The heating system can be dimensioned so that normally one wall or ceiling area suffices to cover the base load. Within the framework of this project optimum dimensioning of such systems is gone into. It shows that the integration of other building services into wall components does not seem to be sensible. (BWI) With 8 figs.

3528 (IBP-GB–72/91) **Component-integrated heating system and building services for future construction concepts (hybrid heating systems) - experimental investigation of individual components and a test set-up. Interim report.** Oswald, D. Fraunhofer-Institut fuer Bauphysik, Stuttgart (Germany); Bundesministerium fuer Forschung und Technologie, Bonn (Germany). Jul 1991. 62p. (In German). Contract BMFT 0338928A. Order Number DE93728729. Source: OSTI; NTIS (US Sales Only).

The thermal behaviour when charged and discharged with warm air of 9 different wall and ceiling components is investigated in order to establish their suitability for hybrid systems. Concrete stores most heat energy, wood concrete has the largest phase shift between heat absorption and emission and thus the best useful energy ratio. Tests on a total system with concrete ceiling and lime-sand brickwall with warm air flow showed that on sunny winter days heating energy savings of about 50% can be attained with such systems. (orig.) With 6 tabs., 28 figs.

3529 (LBL–32639) **Indoor ozone concentrations: Ventilation rate impacts and mechanisms of outdoor concentration attenuation.** Cano-Ruiz, J.A.; Modera, M.P.; Nazaroff, W.W. Lawrence Berkeley Lab., CA (United States). Jul 1992. 20p. Sponsored by USDOE, Washington, DC (United States); California Inst. for Energy Efficiency, Berkeley, CA (United States). DOE Contract AC03-76SF00098. (CONF-9209236–1: 13. air infiltration and ventilation conference: ventilation for energy efficiency and optimum indoor air quality, Nice (France), 15-18 Sep 1992). Order Number DE93000633. Source: OSTI; NTIS; GPO Dep.

The classification of outdoor (ambient) air as fresh for the purposes of ventilation is not always appropriate, particularly in urban areas. In many cities of the world, urban air frequently violates health-based air quality standards due to high ozone concentrations. The degree of protection from exposure to ozone offered by the indoor environment depends on the relationship between indoor and outdoor ozone levels. Existing concentration data indicates that indoor/outdoor ozone ratios range between 10 and 80%. This paper analyzes several of the key issues influencing indoor ozone concentrations, including: (1) the degree of penetration of outdoor ozone indoors, (2) removal within the indoor environment (removal at surfaces and within air distribution systems), and (3) the correlation in time between outdoor ozone levels and ventilation rates. A model for calculating the degree of ozone removal in typical building leaks and air distribution systems is described and applied to a range of typical cases. This model indicates that the degree of removal is minimal for most wooden building cracks, but could be significant in leaks in concrete or brick structures, and is strongly dependent on the lining material for air distribution systems. Indoor ozone exposure estimates based on hourly outdoor ozone monitoring data and hour-by-hour weather-based simulations of infiltration rates and building operation are reported for a few residential scenarios. These estimates serve as a basis for exploring the impact of energy-efficient ventilation strategies on indoor ozone exposures.

3530 (ORNL/CON–351) **A study of changes in foundation insulation levels in the United States.** Christian, J.E. (Oak Ridge National Lab., TN (United States)); Voss, M.K. Oak Ridge National Lab., TN (United States); Saint Mary's Coll., Winona, MN (United States). Oct 1992. 83p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. Order Number DE93004029. Source: OSTI; NTIS; GPO Dep.

For almost 10 years the US Department of Energy (DOE) has sponsored a small research effort with. the objective of working with the building industry to see that cost-effective foundation insulation levels are installed in all US buildings. One of the first discoveries in 1983–1984 was that less than 5% of the existing buildings had foundation insulation and less than 30% of new construction included foundation insulation. After producing foundation handbooks, actively working with energy code and standards groups (ASHRAE and Council of American Building Officials: Model Energy Code Committee) conducting told experiments, and developing computer models for predicting energy savings has any measurable progress been made toward the fulfillment of this DOE objective? Also, in order to derive maximum energy savings impact for this ongoing research activity, market feedback of progress toward attainment of the objective is needed. Using the network of building experts available to the Building Thermal Envelope Systems and Materials program, a short mail survey was developed, administered, and results analyzed. This study concludes that foundation insulation usage on new residential buildings has increased from 1982 levels of around 25% to 1992 levels of around 50%. Government handbooks and recent changes in local enforced codes and standards are identified as major contributors to this improvement. Progress has been made but more is needed to capture the remaining 40% of the foundations that should be insulated. Several issues are reported as obstacles that need to be overcome to capture the remainder of the foundation market.

3531 (PNL-SA–21094) **Field study of energy-efficient showerheads.** Bailey, S.A. (Pacific Northwest Lab., Richland, WA (United States)); Warwick, W.M.; Lauhala, A.J.; Hickman, C.H.; Dent, C.L. Pacific Northwest Lab., Richland, WA (United States). Sep 1992. 15p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. (CONF-920828–19: American Council for an Energy-Efficient Economy (ACEEE) summer study on energy efficiency in buildings, Pacific Grove, CA (United States), 30 Aug - 5 sep 1992). Order Number DE93001550. Source: OSTI; NTIS; GPO Dep.

In August 1991, the Bonneville Power Administration (Bonneville) initiated an energy-efficient showerhead performance assessment project. Approximately 98 homes are participating in this study. All are metered under the Regional End-Use Metering Program (REMP), which is operated by the Pacific Northwest Laboratory (PNL) for Bonneville. Hourly pre- and post-retrofit electrical water heating consumption data will be analyzed using the REMP data archive. The goal of this study is to identify factors affecting energy savings from retrofit of energy-efficient shower heads which will be used to develop an "algorithm" to credit participants in retrofit programs with savings. This algorithm must be easy to apply, credible, and adoptable to conditions which may vary among utilities in Bonneville's Pacific Northwest service area. This field data collection project was designed to collect information about site and occupant characteristics that may affect participation and performance. These data are used to verify or modify assumptions used in engineering models to project energy savings. Estimates of measure performance based on comparisons of energy use are not included in this paper because sufficient post-retrofit data is not yet available. Field data failed to confirm several critical assumptions used to project energy savings. Showerhead water flow rates and anticipated reductions from the retrofit measures were less than expected. Participation in this voluntary study was relatively low considering its risk- and cost-free design. Finally, barriers were encountered that prevented retrofits at some participating sites. The cumulative effect of all factors could reduce projected savings 70% over initial engineering estimates, if 100% participation is assumed.

3202 Transportation

Refer also to citation(s) 3497

3532 (CONF-930120–1) **Fleet vehicles in the United States.** Miaou, Shawpin (Oak Ridge National Lab., TN (United States)); Hu, P.S.; Young, J.R. Oak Ridge National Lab., TN (United States). Jul 1992. 25p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. From 72. Transportation Research Board meeting; Washington, DC (United States); 10-14 Jan 1993. Order Number DE92018494. Source: OSTI; NTIS; GPO Dep.

As fleets become a larger proportion of the new vehicle population on the road, they have more influence on the characteristics of the total US motor vehicle population. Because of the relatively large market share and the high turnover rate of fleet vehicles, fleets have long been considered as a useful initial market for alternative fuel vehicles. In order to analyze fleet market potential of alternative fuel vehicles and to assess infrastructure requirements for successful operations of these vehicles in the future, information on fleet sizes and composition, fleet vehicle operating characteristics, fuel efficiency, and refueling practices, is essential. No comprehensive nationwide fleet vehicle survey is currently available. To gather and summarize information from the latest data sources available, a study was recently performed at the Oak Ridge National Laboratory for the US Department of Energy. These data sources were found to be incompatible in many cases, and data provided by these data sources were oftentimes sparse. This paper presents the data sources considered and the major findings obtained in that study. Information presented includes (1) vehicle composition by size, business program, and weight, (2) vehicle operating characteristics, such as vehicle replacement cycle, fleet size, annual/daily vehicle miles of travel, the areas (rural, suburbs, urban) where fleet vehicles are operated, and the number and types of garage locations, and (3) fueling practices, including the types of fuel used and whether the vehicles are centrally fueled. Limited data on alternative fuel fleet vehicles already in use are also included.

3533 (CONF-930120–2) **A statistical evaluation of the effects of highway geometric design on truck accident involvements.** Miaou, S.P. (Oak Ridge National Lab., TN (United States)); Lum, H. Oak Ridge National Lab., TN (United States). Aug 1993. 24p. Sponsored by USDOE, Washington, DC (United States); Federal Highway Administration, Washington, DC (United States). DOE Contract AC05-84OR21400. From 72. Transportation Research Board meeting; Washington, DC (United States); 10-14 Jan 1993. Order Number DE92040025. Source: OSTI; NTIS; GPO Dep.

This paper illustrates how the Poisson regression model can be used (1) to evaluate the effects of highway geometric design on truck accident involvement rates, and (2) to estimate and quantify the uncertainties of the expected reductions in truck accident involvements from various improvements in highway geometric design. The data source used in this study was the Highway Safety Information System (HSIS), a highway safety data base administered by the Federal Highway Administration (FHWA). Five years of highway geometric, traffic, and truck accident data for rural Interstate highways in one of the HSIS State from 1985 to 1989 were used for illustrations.

3534 (ORNL/CON–335) **Alternative non-CFC mobile air conditioning.** Mei, V.C.; Chen, F.C.; Kyle, D.M. Oak Ridge National Lab., TN (United States). Sep 1992. 90p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. Order Number DE93003670. Source: OSTI; NTIS; GPO Dep.

Concern about the destruction of the global environment by chlorofluorocarbon (CFC) fluids has become an impetus in the search for alternative, non-CFC refrigerants and cooling methods for mobile air conditioning (MAC). While some alternative refrigerants have been identified, they are not considered a lasting solution because of their high global warming potential, which could result in their eventual phaseout. In view of this dilemma, environmentally acceptable alternative cooling methods have become important. This report, therefore, is aimed mainly at the study of alternative automotive cooling methodologies, although it briefly discusses the current status of alternative refrigerants. The alternative MACs can be divided into work-actuated and heat-actuated systems. Work-actuated systems include conventional MAC, reversed Brayton air cycle, rotary vane compressor air cycle, Stirling cycle, thermoelectric (TE) cooling, etc. Heat-actuated MACs include metal hydride cooling, adsorption cooling, ejector cooling, absorption cycle, etc. While we are better experienced with some work-actuated cycle systems, heat-actuated cycle systems have a high potential for energy savings with possible waste heat applications. In this study, each alternative cooling method is discussed for its advantages and its limits.

3203 Industrial and Agricultural Processes

Refer also to citation(s) 2694, 2938, 3466, 3475, 3497, 4155, 4228

3535 (CONF-9109358– vp.) **Meeting water quality criteria for a metal finishing industry.** Veale, F.J. Jr. (Texas Instruments Inc., Attleboro, MA (United States)); Elliott, M.J.; Kelleher, C.M. USDOE, Washington, DC (United States). [1991]. From 8. international conference on chemistry for protection of the environment; Lublin (Poland); 16-18 Sep 1991. In *Chemistry for protection of the environment, Eight international conference: Proceedings.* 635p. Order Number DE92014317. Source: OSTI; NTIS; INIS.

In 1982, when Texas Instruments submitted a renewal application for its National Pollutant Discharge Elimination System (NPDES) permit, water quality criteria were used in place of BAT (Best Available Technology) to determine permit limits. Since it had been shown that BAT was insufficient to achieve water qualities in receiving streams equal to their designated uses, the EPA began imposing much more stringent limits to attain the necessary water quality standards. Therefore the draft NPDES permit issued to Texas Instruments in January 1984 reflected the stringent water quality guidelines. Due to the limited dilution water available in the company's receiving stream, the proposed limits were impossible

to meet with any existing technology. TI decided to pilot test several advanced waste treatment technologies to see if the resulting effluent could meet water quality criteria. Among the technologies tested were: membrane microfiltration; chelating ion exchange; soluble (sodium) sulfide precipitation; and insoluble (ferrous) sulfide precipitation. After several months of intensive pilot testing, the Insoluble Sulfide Precipitation (ISP) process demonstrated the most favorable results as a final polishing step after the existing metal hydroxide treatment process. TI operated an ISP pilot system at an average rate of 40 gpm. To evaluate performance with respect to water quality criteria; toxicity testing and metal analysis were performed on the pilot unit final effluent. As a result of the toxicity test results, it was possible to obtain some relief from the unrealistic draft permit limits.

3536 (CONF-9109358–, pp. 15) **Acid recovery from etching effluents by diffusion dialysis.** Wisniewski, Jacek (Technical University of Wroclaw (Poland)); Winnicki, Tomasz; Suder, Stanislaw. USDOE, Washington, DC (United States). [1991]. From 8. international conference on chemistry for protection of the environment; Lublin (Poland); 16-18 Sep 1991. In *Chemistry for protection of the environment, Eight international conference: Proceedings.* 635p. Order Number DE92014317. Source: OSTI; NTIS; INIS.

In the present study acids were recovered from the etching effluent. The wastewater stream contained sulfuric acid (168 g/dm^3), hydrochloric arid (18 g/dm^3), and iron ions (14 g/dm^3). The dialysis process was run in the ten-compartment diffusion dialyzer with a unit transfer area of 43 cm^2, equipped with Selemion AMV membranes. In system I, with the volume ratio of dialysate to diffusate 1:1.5, the recovery coefficient of hydrochloric acid and sulfuric acid amounted to 61% and 45%, respectively. In system II (volume ratio 1:10), acid recovery coefficient equaled 93% and 53%, respectively. Retention coefficient of iron ions was very high in both versions and amounted to 99% and more.

3537 (CONF-9109358–, pp. 12) **The cyanide emission to atmosphere during its electrochemical destruction in concentrated electrolytes.** Stefanowicz, T. (Poznan Technical University (Poland)); Napieralska-Zagorda, S.; Oskinska, M.; Kruk, K. USDOE, Washington, DC (United States). [1991]. From 8. international conference on chemistry for protection of the environment; Lublin (Poland); 16-18 Sep 1991. In *Chemistry for protection of the environment, Eight international conference: Proceedings.* 635p. Order Number DE92014317. Source: OSTI; NTIS; INIS.

Trials show that when alkaline cyanide solutions are subjected to electrochemical oxidation on anodes at temperature of 93°C, cyanide destruction as well as cyanide emission to atmosphere occurs. It was found, that some cyanide emission occurs when the solution is heated without electrolysis and it significantly increases when electrolysis is applied. Said cyanide emission decreases: (a) if NaCl is added to the electrolyte; (b) if cyanide concentration in treated solution drops; (c) if cyanide is complexed e.g. by nickel. The conclusion is drawn that exhaust gases form cyanide destruction cells prior to release to the atmosphere should be treated e.g. by NaOCl solution to destroy cyanide evolved in a gaseous phase.

3538 (CONF-9109358–, pp. 22) **Treatment of hazardous industrial wastewater and contaminated groundwater using electron beam irradiation.** Kurucz, C.N. (University of Miami, Coral Gables, FL (United States)); Waite, T.D.; Cooper, W.J.; Nickelsen, M.G.; Lin, K.J. USDOE, Washington, DC (United States). [1991]. From 8. international conference on chemistry for protection of the environment; Lublin (Poland); 16-18 Sep 1991. In *Chemistry for protection of the environment, Eight international conference: Proceedings.* 635p. Order Number DE92014317. Source: OSTI; NTIS; INIS.

Electron beam irradiation is proving to be an effective method for removing toxic organic compounds from dilute aqueous waste streams. The removal results from the action of highly reactive species (OH·, e^-_{aq}, H·) generated when high energy electrons penetrate water. The process is effective against mixtures of organic compounds such as those found in industrial wastewaters and contaminated groundwaters. Experiments have been conducted at the Electron Beam Research Facility (EBRF) located at the Miami Dade Central District Waste Treatment Plant in Miami, Florida. The EBRF houses a 1.5 MeV, 50 mA electron accelerator which delivers doses up to 800 krads and utilizes an insulated core transformer (ICT) power supply. Potable water, chlorinated secondary wastewater, and sludge (2-8% solids) influent lines con be connected to the system and the influent stream irradiated at flows up to 520 liters per minute (140 gpm). Selected toxic organics can be injected into a chosen influent stream and irradiated at different doses. Batch experiments using 23,000 liter (6000 gallon) tank trucks can also be performed. The compounds to be studied can either be injected into the wastewater as it is pumped from the tank truck or added directly to the water in the tank truck along with other material such as soil. This allows the simulation of a wide variety of wastewaters and sludges. Removal efficiencies have been determined for various halogenated methanes, ethanes, ethenes and propanes, phenols, and polynuclear aromatic compounds. This paper will present representative removal data on these and other compounds in various simulated wastewaters and results from recent continuous recirculation experiments.

3539 (CONF-9109358–, pp. 12) **Electrochemical purification of lyes after mercerization.** Socha, A. (Technical University of Lodz (Poland)); Gorzka, Z.; Chrzescijanska, E.; Kazmierczak, M. USDOE, Washington, DC (United States). [1991]. From 8. international conference on chemistry for protection of the environment; Lublin (Poland); 16-18 Sep 1991. In *Chemistry for protection of the environment, Eight international conference: Proceedings.* 635p. Order Number DE92014317. Source: OSTI; NTIS; INIS.

This paper presents the method of wastewater treatment of applying electro-oxidation to organic substances and causing their sedimentation from the lyes used in mercerization. Investigations of electrochemical oxidation were carried out using a titanium electrode coated with layer of RuO_2 and TiO_2 oxides. The most advantageous results were obtained at potential 600 mV versus saturated calomel electrode and a current density 0.5 A/dm^2. It was found that the application of electrochemical oxidation allowed about twofold acceleration in liberation of organic compounds contained in lyes, as compared with natural sedimentation. The process of electrolysis brings about twofold increase in the amount of liberated organic compounds.

3540 (CONF-9109358–, pp. 22) **Meeting water quality criteria for a metal finishing industry.** Veale, F.J. (Texas Instruments Incorporated, Attleboro, MA (United States)); Elliott, M.J.; Kelleher, C.M. USDOE, Washington, DC (United States). [1991]. From 8. international conference on chemistry for protection of the environment; Lublin (Poland); 16-18 Sep 1991. In *Chemistry for protection of the environment, Eight international conference: Proceedings.* 635p. Order Number DE92014317. Source: OSTI; NTIS; INIS.

In 1982, when Texas Instruments submitted a renewal application for its NPDES discharge permit, water quality criteria were used in place of BAT to determine permit limits. Since it had been shown that BAT was insufficient to achieve water qualities in receiving streams equal to their designated uses, the EPA began imposing much more stringent limits to attain the necessary water quality standards. Therefore the draft NPDES permit issued to Texas Instruments in January 1984 reflected the stringent water quality guidelines. Due to the limited dilution water available in the company's receiving stream, the proposed limits were impossible to meet with any existing technology. Texas Instruments then faced a difficult decision on whether to attempt to relieve the tight proposed limits through aquatic toxicity testing, or to re-direct the effluent to another receiving stream [that is, Publicly Owned Treatment works(POTW)], or in the worst case, whether to shut down its large Attleboro based manufacturing facility employing over 5000 people and relocate to another area. In the final analysis and after much deliberation, TI chose to maintain its Attleboro facility and enter into a long and relatively unexplored avenue of aquatic toxicity testing to raise its permit levels to achievable limits. It was realized early on, that, even if TI succeeded in raising the limits, the existing waste treatment facility would require extensive modifications.

3541 (DOE/CE/15427–T14) **Non-catalytic steam hydrolysis of fats: Final report.** Deibert, M.C. Montana State Univ., Bozeman, MT (United States). Dept. of Chemical Engineering. 28 Aug 1992. 98p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG01-89CE15427. Order Number DE92040998. Source: OSTI; NTIS; GPO Dep.

Hydrolysis of fats and oils produces fatty acid and glycerol. The catalyzed, liquid phase Colgate-Emry process, state-of-the-art, produces impure products that require extensive energy investment for their purification to commercial grade. Non-catalytic steam hydrolysis may produce products more easily purified. A bench-scale hydrolyzer was designed and constructed to contact descending liquid fat or oil with rising superheated steam. Each of the five stages in the reactor was designed similar to a distillation column stage to promote intimate liquid-gas contact. Degree of hydrolysis achieved in continuous tests using tallow feed were 15% at 280C and 35% at 300C at a tallow-to-steam mass feed ratio of 4.2. At a feed ratio of 9.2, the degree of hydrolysis was 21% at 300C. Decomposition was strongly evident at 325C but not at lower temperatures. Soybean oil rapidly polymerized under reaction conditions. Batch tests at 320C produced degrees of hydrolyses of between 44% and 63% using tallow and palm oil feeds. Over 95% fatty acids were present in a clean, readily separated organic portion of the overhead product from most tests. The test reactor had serious hydraulic resistance to liquid down-flow which limited operation to very long liquid residence times. These times are in excess of those that tallow and palm oil are stable at the reaction temperature. Little glycerol and extensive light organics were produced indicating that unexplained competing reactions to hydrolysis occurred in the experimental system. Further tests using an improved reactor will be required.

3542 (ECN-RX–92-032) **DIANA: An application of methods for diagnosis of continuous dynamic systems.** Reinders, M. (Netherlands Energy Research Foundation, Petten (Netherlands)); Pos, A. Netherlands Energy Research Foundation (ECN), Petten (Netherlands). Jun 1992. 14p. Order Number DE92557271. Source: OSTI; NTIS (US Sales Only).

To be published in the working notes of the ECAI'92 workshop on model-based reasoning, Vienna, August 1992.

Existing methods for an intended application for monitoring and diagnosis of a heat-power coupling device are evaluated and extended. Only a few methods in model-based diagnosis take advantage of the available design model by using (semi)-qualitative abstractions of ordinary differential equations. Diagnosis of complex devices benefits from hierarchical models, both from a modelling perspective as from a computational perspective. The hierarchical diagnosis method DIAMON is preferred. An extension of DIAMON is proposed, called DYANE, that is suitable for on-line diagnosis and uses an alternative method for dynamic model zooming, which is based on heuristics regarding parsimony of diagnoses and consistency of fault models. 1 fig., 1 tab., 14 refs.

3543 (ENEL-CRTN-G14–91-02) **Arcel simulation model to perform thermal behaviour of storage in soil below greenhouse.** Parrini, F.; Vitale, S.; Biondo, A.; Lo Cicero, R. Ente Nazionale per l'Energia Elettrica, Milan (Italy). Centro Termica e Nucleare. 1991. 7p. (CONF-910802–8: World congress of the International Solar Energy Society, Denver, CO (United States), 19-23 Aug 1991). Order Number DE93729463. Source: OSTI; NTIS (US Sales Only).

Recently, ENEL (Italian National Electricity Board) carried out a series of experimental and theoretical studies on greenhouse management, focusing attention on energy savings and the utilization of low temperature water discharged by thermoelectric power plants. This paper presents the new version of the mathematical model, ARCEL, that was improved in order to describe the thermal behaviour of greenhouses whenever trapped heat, giving rise to overheating, can be stored in the ground below. The 'greenhouse system', so arranged, can then store heat, not immediately necessary for use, in the ground by recirculating the heated air inside pipes buried in the ground. The goal of this system is: to store heat during sunny days in order to use it either during night time or when required. The numerical model includes a set of energy balance equations, assembled by means of a implicit finite difference method, in order to represent simultaneous energy and mass transfer. The mathematical model was implemented in Fortran 77 computer language.

3544 (ETDE-mf–93728736) **Development of technology for energy saving in obtaining plant products. Preliminary final report.** Hannover Univ. (Germany). Inst. fuer Zierpflanzenbau; Ministerium fuer Wissenschaft und Kunst des Landes Niedersachsen, Hannover (Germany). 26 Jul 1990 17p. (In German). Order Number DE93728736. Source: OSTI; NTIS (US Sales Only).

The renewed checking of the dynamic control strategies developed or improved in this project confirmed the applicability of the principle of integration in controlling the climate in greenhouses. Using the dynamic temperature program examined here, plants of similar quality and culture time could be produced as with conventional static temperature control are in the range of 10-30%, depending on the technical equipment and the outside climatic conditions. The suitability and applicability of the listed strategies for gardening practice depends, apart from the technical conditions (equipping with control equipment, energy shielding etc), above all on the production targets aimed at, the time of year and the phytosanitary points of view. (orig.).

3545 (PNL–8296) **Final report on the PNL program to develop an alumina sensor: Sensors Development Program.** Windisch, C.F. Jr.; Brenden, B.B.; Koski, O.H.; Williford, R.E. Pacific Northwest Lab., Richland, WA (United States). Oct 1992. 77p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE93001662. Source: OSTI; NTIS; GPO Dep.

An alumina concentration sensor was required to ensure safe operating conditions for cermet inert anodes that were under development at the Pacific Northwest Laboratory (PNL)(a) for the electrolytic production of aluminum metal. The Sensors Development Program at PNL was conducted in response to this need for an alumina sensor. In all, eight different approaches to developing an alumina sensor were evaluated as part of this program. Each approach sought to correlate alumina concentration either to some spectral, physical, or electrical property of the molten electrolytic, or alternatively, to some operational characteristic of the reduction cell such as the integrity of the cermet anodes or the electrical noise generated by them during cell operation. The studies on electrical noise were performed using a large number of digital signal analysis (DSA) methods. There were two primary requirements for success for an alumina sensor to be used in conjunction with cermet anodes: (1) adequate sensitivity to alumina concentration at concentrations close to saturation, and (2) ease of use in an industrial setting. After numerous laboratory experiments as well as field studies in some cases, it was concluded that none of the approaches sufficiently satisfied the two criteria to serve as the basis for an alumina sensor. If further work is to continue in this area, it is recommended that the research focus on alternative DSA approaches, primarily because DSA methods would be so easy to use in an industrial environment. Due to the lack of correlation using DSA in the present work, however, it is recommended that alternative strategies for data collection and analysis be used in any further development activities.

3546 (PNL-SA–20301) **Pull remanufacturing: A case study.** Levine, L.O. Pacific Northwest Lab., Richland, WA (United States). Sep 1992. 5p. Sponsored by Department of Defense, Washington, DC (United States). DOE Contract AC06-76RL01830. (CONF-9209242–1: 1992 American Production of Inventory Control Society (APICS) remanufacturing seminar, Salt Lake City, UT (United States), 23-25 Sep 1992). Order Number DE93001548. Source: OSTI; NTIS; GPO Dep.

This paper describes how pull production methods have been applied to a manual transmission remanufacturing line at Tooele Army Depot in Utah. The paper emphasizes techniques for linking the control of disassembly and cleaning operations to the repair and assembly portions of the production system (PP&C). The primary objective is to show that production planning and control can be simplified when pull mechanisms are combined with shop floor improvements. One approach to applying MRP II to remanufacturing is to use a separate production schedule for the disassembly and assembly portions of the operation. This approach is primarily needed when managing the delivery and inventory of cores is critical to the successful operation of a remanufacturing organization. Because Army depots frequently have an adequate inventory of cores on hand (somewhere on-site), this requirement is usually less significant. Therefore, it is possible to eliminate the use of a

master production schedule for disassembly and rely on pull linkages from the repair and assembly operations to control the activity of the disassembly and cleaning operations. In remanufacturing environments having multiple products and adequate buffers of core inventory, effective coordination of disassembly and cleaning functions with assembly production requirements becomes a key production control issue.

3547 (PNL-SA–20309) **Initiating continuing improvement within Greenfield sites: A federal remanufacturing facility case study.** Montgomery, J.C.; Paul, B.K. Pacific Northwest Lab., Richland, WA (United States). Sep 1992. 7p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. (CONF-9209242–3: 1992 American Production of Inventory Control Society (APICS) remanufacturing seminar, Salt Lake City, UT (United States), 23-25 Sep 1992). Order Number DE93001506. Source: OSTI; NTIS; GPO Dep.

The setting for this study was a federal government remanufacturing depot, responsible for the replacement and overhaul of large wheeled vehicles. These vehicles include 2.5 and 5 ton trucks and their major subordinate component items such as engines, axles, and transmissions. At the time of the case study the depot was involved in the design and construction of a 400,000 square foot hard metal subordinate items remanufacturing facility. The purpose of the facility was to consolidate all existing subordinate item remanufacturing under one roof. Commodity items to be remanufactured within the facility included engines, transmissions, transfer cases, axles, differentials, power generators, and other components. From the onset, the concept of consolidating existing processes under one roof had posed a significant material handling problem. Digital simulation was used to analyze material flow patterns within the new facility. As a result it was determined that, without changing the existing flow of material between processes, significant choke points would form in the areas of shared-capacity resources such as cleaning and painting. It was estimated that these choke points, representing piles of work-in-process (WIP) inventory, would clog aisles and prevent forklifts from making essential deliveries. Thus, a strategy was needed for controlling the buildup of WIP inventory within the new facility. To accomplish this objective, a program was begun to certify the WIP inventory levels of each subordinate item commodity line within existing facilities prior to the move into the new facility. This program focused on training workers in new methods of inventory control, production control, and quality control needed to minimize the WIP levels required within the new facility.

3548 (PNL-SA–20744) **Pull-production in repetitive remanufacturing.** McCaskey, D.W. Jr. Pacific Northwest Lab., Richland, WA (United States). Sep 1992. 8p. Sponsored by Department of Defense, Washington, DC (United States). DOE Contract AC06-76RL01830. (CONF-9209242–2: 1992 American Production of Inventory Control Society (APICS) remanufacturing seminar, Salt Lake City, UT (United States), 23-25 Sep 1992). Order Number DE93001549. Source: OSTI; NTIS; GPO Dep.

In the past, production activity control practices in most repetitive remanufacturing facilities resembled those used in intermittent production operations. These operations were characterized by large amounts of work-in-process (WIP), frequent work stoppages due to part shortages, excessive overtime, low product velocity, informal scheduling between dependent operations, low employee and management moral, and a lot of wasted time, material, labor, and space. Improvement in production activity control (PAC) methods for repetitive remanufactures has been hampered by uncertainty in: supply of incoming assets, configuration of assets, process times to refurbish assets, and yields in reclamation processes. collectively these uncertainties make shop floor operations seem uncontrollable. However, one United States Army depot has taken on the challenge. Through management supported, cross-functional teams, the Tooele Army Depot has designed and implemented pull-production systems for two of its major products, with several others to follow. This article presents a generalized version of Tooele's pull-production system and highlights design characteristics which are specific to remanufacturing applications.

3206 Municipalities and Community Systems

Refer also to citation(s) 3499, 3505, 4179

3549 (CONF-9110402–2) **Microbial populations and decomposition activity in three subsurface flow constructed wetlands.** Hatano, K. (North Carolina State Univ., Raleigh, NC (United States)); Trettin, C.C.; House, C.H.; Wollum, A.G. II. Oak Ridge National Lab., TN (United States). [1991]. 20p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. From Conference on constructed wetlands for water quality improvement; Pensacola, FL (United States); 21-24 Oct 1991. Order Number DE93001641. Source: OSTI; NTIS; GPO Dep.

Metabolic activity of microorganisms is the primary mechanism for organic matter degradation in constructed wetlands. However, the occurrence and abundance of different types of microorganisms responsible for degradation reactions has not been widely studied. The objective of this paper is to characterize the distribution and abundance of microorganisms in three constructed wetlands and evaluate their potent decomposition activity.

3550 (DOE/CE/26565–T1) **Reduction of pumping energy losses in district heating and cooling systems: Final report.** Zakin, J.L.; Christensen, R.N. Ohio State Univ., Columbus, OH (United States). Oct 1992. 11p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG01-86CE26565. Order Number DE93002508. Source: OSTI; NTIS; GPO Dep.

This project was designed to find effective surfactant friction reducing additives for use in district heating systems with temperatures of 50 to 90°C and effective additives fore district cooling systems with temperatures of 5 to 15°C. Heat transfer measurements in conventional shell and tube heat exchangers and in plate heat exchangers were also carried out to see how seriously these surfactant drag reducing additives reduce heat transfer coefficients.

3551 (ETDE-IT–92-93) **Demand side management in electric utility planning: Illustrative examples.** Grattieri, W.; Insinga, F. Ente Nazionale per l'Energia Elettrica, Milan (Italy). Centro di Ricerca Elettrica. 1991. 29p. (In Italian). (CONF-9112143–1: Alimentazione elettrica delle grandi aree urbane, Milan (Italy), 10-11 Dec 1991). Order Number DE93729460. Source: OSTI; NTIS (US Sales Only).

Recently, electric utilities have begun to make better use of demand side management strategies to get the most out of their plants and reduce unit energy consumption. Demand side management, together with suitable marketing strategies, heightens consumer awareness regarding the optimum use of electric power, as well as, the diversity of its uses. In the past, electric utilities failed to take full advantage of the potential of demand side management techniques because attention was focussed mainly on production. Now, new opportunities are being discovered with the incorporation of demand side management in power distribution system planning; investment strategies are being improved and operating costs reduced by the optimization of resource use and the reduction of line losses. Decisions are now being made in such a way as to have a direct impact on how the consumer uses electricity and on how much electricity he uses; thus utilities are better able to adjust their systems' time dependent load characteristics to best suit the specific capabilities of their power plants and distribution systems. This paper assesses the state-of-the-art in demand side management and gives some examples of its effective implementation by major utilities around the world.

3552 (NREL/TP–431-4982) **RD & D priorities for energy production and resource conservation from municipal solid waste.** National Renewable Energy Lab., Golden, CO (United States); ICF, Inc., Fairfax, VA (United States). Aug 1992. 268p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC02-83CH10093. Order Number DE92016406. Source: OSTI; NTIS; GPO Dep.

This report identifies research, development, and demonstration (RD&D) needs and priorities associated with municipal solid waste (MSW) management technologies that conserve or produce energy or resources. The changing character of MSW waste management and the public's heightened awareness of its real and perceived benefits and costs creates opportunities for RD&D in MSW

technologies. Increased recycling, for example, creates new opportunities for energy, chemicals, and materials recovery. New technologies to control and monitor emissions from MSW combustion facilities are available for further improvement or application. Furthermore, emerging waste-to-energy technologies may offer environmental, economic, and other advantages. Given these developments, DOE identified a need to assess the RD&D needs and pdodties and carefully target RD&D efforts to help solve the carbon's waste management problem and further the National Energy Strategy. This report presents such an assessment. It identifies and Documents RD&D needs and priorities in the broad area of MSW resource . recovery, focusing on efforts to make MSW management technologies commercially viable or to improve their commercial deployment over a 5 to l0 year period. Panels of technical experts identifies 279 RD&D needs in 12 technology areas, ranking about one-fifth of these needs as priorities. A "Peer Review Group" identified mass-burn combustion, "systems studies," landfill gas, and ash utilization and disposal as high priority areas for RD&D based on cost and the impacts of further RD&D. The results of this assessment are intended to provide guidance to DOE concerning possible future RD&D projects.

3209 Education and Public Relations

Refer also to citation(s) 3551

33 ADVANCED PROPULSION SYSTEMS

3301 Internal Combustion Engines

Refer also to citation(s) 2497

3553 (ORNL/Sub–89-SE500/1) **Evaluation and silicon nitride internal combustion engine components: Final report, Phase I.** Voldrich, W. (Allied-Signal Aerospace Co., Torrance, CA (United States). Garrett Ceramic Components Div.). Oak Ridge National Lab., TN (United States); Allied-Signal Aerospace Co., Torrance, CA (United States). Garrett Ceramic Components Div. Apr 1992. 75p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. Order Number DE93003628. Source: OSTI; NTIS; GPO Dep.

The feasibility of silicon nitride (Si_3N_4) use in internal combustion engines was studied by testing three different components for wear resistance and lower reciprocating mass. The information obtained from these preliminary spin rig and engine tests indicates several design changes are necessary to survive high-stress engine applications. The three silicon nitride components tested were valve spring retainers, tappet rollers, and fuel pump push rod ends. Garrett Ceramic Components' gas-pressure sinterable Si_3N_4 (GS-44) was used to fabricate the above components. Components were final machined from densified blanks that had been green formed by isostatic pressing of GS-44 granules. Spin rig testing of the valve spring retainers indicated that these Si_3N_4 components could survive at high RPM levels (9,500) when teamed with silicon nitride valves and lower spring tension than standard titanium components. Silicon nitride tappet rollers showed no wear on roller O.D. or I.D. surfaces, steel axles and lifters; however, due to the uncrowned design of these particular rollers the cam lobes indicated wear after spin rig testing. Fuel pump push rod ends were successful at reducing wear on the cam lobe and rod end when tested on spin rigs and in real-world race applications.

3303 Electric-Powered Systems

Refer also to citation(s) 3475, 3476, 3521, 3557

3554 (CONF-9210183–Vol.1) **S/EV 92 (Solar and Electric Vehicles): Proceedings: Volume 1.** Northeast Sustainable Energy Association, Greenfield, MA (United States). [1992]. 241p. Sponsored by USDOE, Washington, DC (United States). From Northeast Sustainable Energy Association meeting; Boston, MA (United States); 9-10 Oct 1992. Order Number DE93001501. Source: OSTI; NTIS; GPO Dep.

Volume I of these proceedings presents current research on solar and electric powered vehicles. Both fundamental and advanced concepts concerning electric vehicles are presented. The use of photovoltaic cells in electric vehicles and in a broader sense as a means of power generation are discussed. Information on electric powered fleets and races is included. And policy and regulations, especially pertaining to air quality and air pollution abatement are presented.

3555 (DOE/ID/13074–T5) **Kansas State University (KSU), DOE EV Site Operator Program: First quarter report, July 1–September 30, 1992.** Hague, J.R. Kansas State Univ., Manhattan, KS (United States). 17 Nov 1992. 16p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FC07-91ID13074. Order Number DE93003161. Source: OSTI; NTIS; INIS; GPO Dep.

Kansas State University, with funding support from federal, state, public, and private companies, is participating in the Department of Energy's Electric Vehicle Site Operator Program. Through participation in this program, Kansas State is demonstrating, testing, and evaluating electric or hybrid vehicle technology. This participation will provide organizations the opportunity to examine the latest EHV prototypes under actual operating conditions. KSU proposes to purchase one (1) electric or hybrid van and four (4) electric cars during the first two years of this five-year program. KSU has purchased one G-Van built by Conceptor Industries, Toronto, Canada and has initiated a procurement order to purchase two (2) Soleq 1992 Ford EVcort station wagons. The G-Van has been signed in order for the public to be aware that this is an electric drive vehicle. Financial participant's names have been stenciled on the back door of the van. This vehicle is available for short term loan to interested utilities and companies. When other vehicles are obtained, the G-Van will be maintained on K-State's campus.

3556 (NREL/TP–262-4678) **Environmental, health, and safety issues of sodium-sulfur batteries for electric and hybrid vehicles: Volume 1, Cell and battery safety.** Ohi, J.M. National Renewable Energy Lab., Golden, CO (United States). Sep 1992. 30p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC02-83CH10093. Order Number DE92016431. Source: OSTI; NTIS; GPO Dep.

This report is the first of four volumes that identify and assess the environmental, health, and safety issues involved in using sodium-sulfur (Na/S) battery technology as the energy source in electric and hybrid vehicles that may affect the commercialization of Na/S batteries. This and the other reports on recycling, shipping, and vehicle safety are intended to help the Electric and Hybrid Propulsion Division of the Office of Transportation Technologies in the US Department of Energy (DOE/EHP) determine the direction of its research, development, and demonstration (RD&D) program for Na/S battery technology. The reports review the status of Na/S battery RD&D and identify potential hazards and risks that may require additional research or that may affect the design and use of Na/S batteries. This volume covers cell design and engineering as the basis of safety for Na/S batteries and describes and assesses the potential chemical, electrical, and thermal hazards and risks of Na/S cells and batteries as well as the RD&D performed, under way, or to address these hazards and risks. The report is based on a review of the literature and on discussions with experts at DOE, national laboratories and agencies, universities, and private industry. Subsequent volumes will address environmental, health, and safety issues involved in shipping cells and batteries, using batteries to propel electric vehicles, and recycling and disposing of spent batteries. The remainder of this volume is divided into two major sections on safety at the cell and battery levels. The section on Na/S cells describes major component and potential failure modes, design, life testing and failure testing, thermal cycling, and the safety status of Na/S cells. The section on batteries describes battery design, testing, and safety status. Additional EH&S information on Na/S batteries is provided in the appendices.

3304 Hybrid Systems

Refer also to citation(s) 3475, 3476, 3554, 3556

3557 (DOE/ID–10385) **Development of test procedures for hybrid/electric vehicles.** Burke, A.F. EG and G Idaho, Inc., Idaho Falls, ID (United States). Jul 1992. 98p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC07-76ID01570. Order Number DE93001943. Source: OSTI; NTIS; GPO Dep.

This report is concerned with the development of procedures for testing of hybrid/electric vehicles to determine their energy consumption and emissions characteristics. Special emphasis is given to hybrid vehicles, which can be operated above some minimum battery state-of-charge in an all-electric mode for all types of driving (city and highway). When the all-electric range of these vehicles is exceeded, the vehicles are operated in the hybrid mode, in which an engine/generator is turned on to generate electricity on-board the vehicle. Key issues in testing hybrid vehicles are identified and discussed. These issues include the test cycles to be used, the instrumentation required, the effect of battery state-of-charge and control strategy in the hybrid mode on the need for repeated test cycles, and the data to be collected and how that data from repeated cycles is interpreted to determine the vehicle energy consumption and emissions characteristics.

3306 Vehicle Design Factors

Refer also to citation(s) 3635, 3636

3307 Emission Control

Refer also to citation(s) 3558

3308 Alternative Fuels

Refer also to citation(s) 2500, 3521

3558 (ANL/CP–77453) **The Natural Gas Vehicle Challenge '92: Exhaust emissions testing and results.** Rimkus, W.A. (Argonne National Lab., IL (United States)); Larsen, R.P.; Zammit, M.G.; Davies, J.G.; Salmon, G.S.; Bruetsch, R.I. Argonne National Lab., IL (United States). [1992]. 22p. Sponsored by USDOE, Washington, DC (United States); Department of Energy, Mines and Resources, Ottawa, ON (Canada); Society of Automotive Engineers, Inc., Warrendale, PA (United States). DOE Contract W-31109-ENG-38. (CONF-9210140–1: International fuels and lubricants meeting and exposition, San Francisco, CA (United States), 19-22 Oct 1992). Order Number DE93002997. Source: OSTI; NTIS; GPO Dep.

The Natural Gas Vehicle (NGV) Challenge '92, was organized by Argonne National Laboratory. The main sponsors were the US Department of Energy the Energy, Mines, and Resources – Canada, and the Society of Automotive Engineers. It resulted in 20 varied approaches to the conversion of a gasoline-fueled, spark-ignited, internal combustion engine to dedicated natural gas use. Starting with a GMC Sierra 2500 pickup truck donated by General Motors, teams of college and university student engineers worked to optimize Chevrolet V-8 engines operating on natural gas for improved emissions, fuel economy, performance, and advanced design features. This paper focuses on the results of the emission event, and compares engine mechanical configurations, engine management systems, catalyst configurations and locations, and approaches to fuel control and the relationship of these parameters to engine. out and tailpipe emissions of regulated exhaust constituents. Nine of the student modified trucks passed the current levels of exhaust emission standards, and some exceeded the strictest future emissions standards envisioned by the US Environmental Protection Agency. Factors contributing to good emissions control using natural gas are summarized, and observations concerning necessary components of a successful emissions control strategy are presented.

3559 (DOE/CS/62018–T1) **First International Alternative Fueled Vehicle Round-Up.** Kansas Corp. Commission, Topeka, KS (United States). [1992]. 14p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG47-80CS62018. Order Number DE93002779. Source: OSTI; NTIS; GPO Dep.

The state of Kansas hosted the First International Alternative Fueled Vehicle Round-Up June 8–9, 1992. This event was conceived and initiated in the Alternative Fuels Program of the Energy Section of the Kansas Corporation Commission (KCC). The objective was to emphasize and publicize the need for and the current viability of alternative fuels to the general public, fleet operators, environmentalists, utility operators, government officials, school systems, transportation providers and others interested in moving toward the usage of cost effective clean-burning domestic fuels. When judging this original objective by the parameters of the participation of industry, media coverage, attendance at the event, satisfaction of the participants and exhibitors, feedback from the public and new activity generated by the high exposure, the Round-Up can be declared and outstanding success which exceeded the hopes and designs originally sought.

35 ARMS CONTROL

3501 Policy, Negotiations, and Legislation

Refer also to citation(s) 3495

3560 (INIS-mf–13369, pp. 55-63) **Nuclear non-proliferation: The promotion of peaceful uses of nuclear energy. (Cairo, Egypt 3-4 March 1992).** Endo, T. International Atomic Energy Agency, Vienna (Austria). Div. of Public Information. Aut 1992. 103p. In *Speaking of nuclear energy: Highlights of proceedings from IAEA Public Information Regional Seminars.* Order Number DE93607987. Source: OSTI; NTIS (US Sales Only); INIS.

First the author discusses the issue of nuclear non-proliferation in general. Then he reviews some problems concerning the current non-proliferation regime and presents his personal views on how the regime might be strengthened.

3503 Verification

Refer also to citation(s) 4062, 4071, 4079, 4080, 4081, 4082, 4083, 4084, 4085, 4086, 4087, 4088, 4089, 4090, 4091, 4092, 4093, 4094, 4095, 4096, 4097, 4098, 4099, 4100

3561 (EGG-PHY–10394) **Imaging System (INEL) development software evaluation.** Partin, J.K.; Lassahn, G.D.; Davidson, J.R. EG and G Idaho, Inc., Idaho Falls, ID (United States). Sep 1992. 25p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC07-76ID01570. Order Number DE93001940. Source: OSTI; NTIS; GPO Dep.

This report gives a description and an evaluation of the software used during the developmental phase of a project to design and produce an automatic target recognition system. The purpose of the Imaging System project is to develop a reconnaissance system that can be attached to and carried aloft by any of several aircraft. This system will include several imaging sensors, among them a visible light camera, an infrared imaging system, and a radar imaging system. Each scene of interest will be photographed by each sensor, so we will have several different images of each scene. The several images will be analyzed by a computer to determine the presence of previously specified objects of interest in the scene. The EG&G Idaho (INEL) part of the overall project is the development of the image analysis computer, an automatic target recognition (ATR) system. This task includes choosing and assembling the computer hardware, developing the ATR algorithms, and developing software to implement the algorithms on the selected hardware. Special requirements for this ATR system include image fusion and uncertainty estimation. "Image fusion" means that the ATR system must analyze the three images jointly to produce a single, high confidence statement of the presence of a target, as opposed to analyzing the three images separately and producing three separate, lower-confidence, possibly contradictory, indications of the presence of targets. "Uncertainty estimation" means that the ATR system must tell the user what confidence the user should have in the ATR system's report of the presence or absence of targets. In addition, there are the common requirements for speed, portability, and low cost of the ATR system. We have completed a fully functional developmental version of the ATR system. This is a

laboratory system, not suitable for field deployment. Future work will make the system easily usable in field applications.

3562 (LA–12340-MS) **Measurements and calculations of the characteristics for a space-based neutron sensor.** Garnett, A. (ed.); Byrd, R.C.; Barraclough, B.L.; Feldman, W.C.; Bame, S.J. Los Alamos National Lab., NM (United States). Oct 1992. 28p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. Order Number DE93001429. Source: OSTI; NTIS (US Sales Only); GPO Dep.

Preliminary estimates of the impact of changes in the mission for space-based verification sensors can be obtained by using computer simulations. This paper describes calculations and measurements to evaluate the performance of representative designs for neutron sensors. The calculations use programs recently developed at Los Alamos National Laboratory to combine physics models for the production of neutrons at high energies with conventional codes for neutron transport at lower energies. Included are discussions of the physics assumptions, comparisons between calculations and laboratory calibrations, energy-dependent detector response functions, investigations of spacecraft background, and several studies of alternative sensor designs. The results provide a basis for future evaluations of detailed proposals for possible sensors.

3563 (UCRL-ID–111866) **Comments on implementation and verification of closure of chemical weapons (CW) production facilities under a CW treaty.** Harrar, J.E. Lawrence Livermore National Lab., CA (United States). Aug 1992. 14p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. Order Number DE93001829. Source: OSTI; NTIS (US Sales Only); GPO Dep.

Shortly after a CW Convention enters into force, States Parties that ratify and accede to the Convention are required to (1) cease production of chemical weapons, (2) implement measures that will render these production facilities inoperable, and (3) eventually destroy the facilities or convert them to other uses. Before the facilities are converted or destroyed, they will be subject to periodic inspection by the Technical Secretariat to verify that they have remained inoperable. Using the lessons learned from recent field exercises that simulated such inspections, this paper discusses some aspects of the technology and protocols for closure and securing of CW production facilities. Recommendations are made concerning the philosophy and specific techniques for closure and secure sealing of the closure. Selection of critical choke points, closure techniques, and seals should ideally be done as a total system design. However, because it is the inspected State Party that initiates the closure design, it is also concluded that careful attention to the details of the protocols for closure design and implementation is required to ensure compliance with the Treaty.

36 MATERIALS

Refer also to citation(s) 2594

3564 (DOE/ER–0567P) **Energy Materials Coordinating Committee (EMaCC) annual technical report, fiscal year 1991.** USDOE Office of Energy Research, Washington, DC (United States). Materials Sciences Div. 31 May 1992. 529p. Sponsored by USDOE, Washington, DC (United States). Order Number DE93003978. Source: OSTI; NTIS; GPO Dep.

EMaCC serves primarily to enhance coordination among the DOE materials programs and to further effective use of materials expertise. This is done through the exchange of budgetary and planning information among program managers and through technical meetings/workshops. Six topical subcommittees were established: electrochemical technologies, metals and intermetallics, radioactive waste containment, semiconductors, structural ceramics, and superconductivity. This report summarizes EMaCC activities for FY 1991 and describes the materials research programs of various offices and divisions within DOE: conservation and renewable energy (buildings, industrial technologies and processes, transportation, utility technologies, energy management); energy research (materials sciences, engineering and geosciences); environmental restoration and waste management; nuclear energy; civilian radioactive waste management; defense; and fossil energy. Paragraph descriptions are given of the research programs. A directory and a keyword index are included.

3565 (DOE/ER/45439–132) **University of Illinois at Urbana-Champaign, Materials Research Laboratory progress report for FY 1992.** Illinois Univ., Urbana, IL (United States). Materials Research Lab. Jul 1992. 189p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG02-91ER45439. Order Number DE93002655. Source: OSTI; NTIS; GPO Dep.

This interdisciplinary laboratory in the College of Engineering support research in areas of condensed matter physics, solid state chemistry, and materials science. These research programs are developed with the assistance of faculty, students, and research associates in the departments of Physics, Materials Science and Engineering, chemistry, Chemical Engineering, Electrical Engineering, Mechanical Engineering, and Nuclear Engineering.

3566 (KFK–5034) **Annual report 1991 on R and D work by the Institute for Materials and Solid State Research (IMF), Karlsruhe Nuclear Research Center.** Kernforschungszentrum Karlsruhe GmbH (Germany). Inst. fuer Materialforschung. Mar 1992. 56p. (In German). Order Number DE93742162. Source: OSTI; NTIS (US Sales Only); INIS.

The annual report summarises the activities of the IMF in the following subject areas: (1) Contributions to the PKF fusion technology project (refewing to structural materials, superconducting magnets, blanket development); (2) PSU, project for the management of pollutants in the environment (treatment and recycling of hazardous waste); (3) solid state and materials research (high-temperature materials, ceramic materials as protective coatings, polymer materials, high-performance ceramics, high-TC superconducting materials; biomechanics, laser technology); (4) microtechnology (development and testing of compact or layered materials in microtechnology); (5) PSF project, nuclear safety, research (safety and materials aspects of fast breeder reactors, transient behaviour of fuel elements in fact breeder reactors, LWR-specific safety research, containment design concepts for the next generation of PWR-type reactors); (6) NE project, nuclear waste management (analysis of solid wastes from the dissolution of spent LWR fuels, materials testing in nitric acid). The primary reports and other publications of the Institute issued in 1991 are listed in an annex. (orig./MM).

3567 (ORNL–6722) **Solid State Division progress report for period ending March 31, 1992.** Green, P.H.; Hinton, L.W. (eds.). Oak Ridge National Lab., TN (United States). Sep 1992. 270p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. Order Number DE93003665. Source: OSTI; NTIS; INIS; GPO Dep.

During this period, the division conducted a broad, interdisciplinary materials research program with emphasis on theoretical solid state physics, superconductivity, neutron scattering, synthesis and characterization of materials, ion beam and laser processing, and the structure of solids and surfaces. The High Flux Isotope Reactor was returned to full operation.

3601 Metals and Alloys

Refer also to citation(s) 2553, 2659, 2666, 2667, 2747, 2857, 2858, 2965, 3029, 3051, 3056, 3057, 3061, 3101, 3315, 3318, 3320, 3321, 3623, 3642, 3791, 3808, 3810, 3812, 3910, 3950, 3952, 4049, 4076, 4466, 4677, 4678, 4679, 4689

3568 (ANL/CP–76028) **Polarized neutron reflection study of the unidirectional magnetic anisotropy of permalloy on $Ni_{0.5}Co_{0.5}O$.** Felcher, G.P. (Argonne National Lab., IL (United States)); Huang, Y.Y.; Carey, M.; Berkowitz, A. Argonne National Lab., IL (United States). Aug 1992. 12p. Sponsored by USDOE, Washington, DC (United States); National Science Foundation, Washington, DC (United States). DOE Contract W-31109-ENG-38. Grant DMR-90-10908. (CONF-9209227–3: Symposium on magnetic ultrathin films, multilayers, and surfaces, Lyon (France), 7-10 Sep 1992). Order Number DE93000509. Source: OSTI; NTIS; INIS; GPO Dep.

Couples of ferromagnetic permalloy/antiferromagnetic metal oxide exhibit unidirectional magnetic anisotropy along a magnetic field applied during cooling. Polarized neutron reflection has been used to check if the effect is due to a bias of the antiferromagnetic configuration in the oxide, where the layer immediately adjacent to the permalloy is polarized parallel to the easy direction of magnetization. The measurements were made on a sample consisting of permalloy/500Å $Ni_{0.05}Co_{0.5}O$. The polarized neutron reflectivities taken at the four corners of the magnetic hysteresis loop at 20K. A faint magnetic signal consistent with the unidirectional bias of the F/AF structure is also observed. This behavior is discussed in the light of the current theories.

3569 (BNL–47545) **EXAFS study of metal-coated particles produced by ball milling.** Heald, S.M.; Jayanetti, S.; Pandya, K.I. Brookhaven National Lab., Upton, NY (United States). [1992]. 3p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC02-76CH00016 ;AS05-80ER10742. (CONF-9208160–3: 7. international conference on x-ray absorption fine structure, Kobe (Japan), 23-29 Aug 1992). Order Number DE93002323. Source: OSTI; NTIS; GPO Dep.

EXAFS measurements have been carried out on mixtures of Sa with Ge and Si, and Pt with SiO_2 which have been ball milled for extended periods. In these systems the brittle component (Ge, Si, or SiO_2) is ground to nanocrystalline dimensions while the ductile metal is found to coat the outer surface the particles. Analysis shows that in the Sn-Ge and Sn-Si systems, mixing at the interface is found to form apparently cubic SnGe and SnSi alloys respectively. In the Pt-SiO_2 system while no mixing is observed, the Pt is found to be highly dispersed on the surface of SiO_2 particles.

3570 (BNL–47976) **The energetics of ordered intermetallic alloys (of the transition metals).** Watson, R.E. (Brookhaven National Lab., Upton, NY (United States)); Weinert, M.; Davenport, J.W.; Fernando, G.W.; Bennett, L.H. Brookhaven National Lab., Upton, NY (United States). [1992]. 40p. Sponsored by USDOE, Washington, DC (United States); National Energy Research Supercomputer Center (United States). DOE Contract AC02-76CH00016. (CONF-9206202–4: NATO advanced study institute on statics and dynamics of alloy phase transformations, Rhodes (Greece), 21 Jun - 3 jul 1992). Order Number DE93001968. Source: OSTI; NTIS; INIS; GPO Dep.

The atomically ordered phases in ordered transition metal alloys are discussed. This chapter is divided into: physical parameters controlling phase stability (Hume-Rothery, structural maps, Miedema Hamiltonian), wave functions & band theory, comment on entropy terms, cohesive energies (electron promotion energies, Hund's rule on orbital effects), structural energies/stabilities of elemental solids, total energies and atomic positions, charge transfer (Au alloys, charge tailing), heats of formation of ordered compounds.

3571 (CONF-920621–1) **Ductility and fracture in $L1_2$ intermetallic alloys.** Horton, J.A. Oak Ridge National Lab., TN (United States). [1992]. 7p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. From 1. Pacific Rim international conference on advanced materials and processing; Hangzhou (China); 23-27 Jun 1992. Order Number DE93001644. Source: OSTI; NTIS; GPO Dep.

This paper provides a comprehensive review of the ductility and fracture in Ni_3Al, was thought to have intrinsically brittle grain boundaries. Because of the dramatic effect boron has on the grain boundaries, much work has focused on analysis of the details of the grain boundary chemistry and structure with and without boron. We now know ductilities of up to 50% are possible in boron-free material, given a defect-free specimen tested in an atmosphere with as little water vapor or hydrogen as possible. Another group of $L1_2$, alloys, such as Al_3Sc and alloys based on the trialuminide Al_3Ti, currently appear to be intrinsically brittle, failing by cleavage with fracture toughness values of around 2 to 3 $MPa \cdot m^{1/2}$. These alloys deform by the expected slip systems, {111}<110>, that provide sufficient deformation modes that should allow ductile behavior. These alloys are generally rather soft with yield strengths as low as 200 MPa and hardnesses as low as 150 DPH, suggesting that dislocation generation and motion is fairly easy in these materials. While a low cleavage energy and a high modulus appear to be the fundamental cause for the complete lack of ductility, the possibility exits that they too are not intrinsically brittle.

3572 (CONF-9211110–1) **The influence of long term thermal aging on the microstructure and mechanical properties of modified 9Cr-1Mo steel.** Brinkman, C.R.; Gieseke, B.; Alexander, D.J.; Maziasz, P.J. Oak Ridge National Lab., TN (United States). [1992]. 23p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. From Microstructure and mechanical properties of aging materials; Detroit, MI (United States); 2-5 Nov 1992. Order Number DE93001373. Source: OSTI; NTIS; GPO Dep.

Results of room- and elevated-temperature tensile and creep tests are reported from tests conducted on three heats of Modified 9Cr-1Mo steel. The heats were thermally aged at various temperatures from 482 to 704°C and at aging times to 75,000 h (8.6 years). Tensile strain rates were also varied in order to determine strain rate sensitivity of tensile properties. Changes in the yield and tensile strengths occurred following exposure to these temperatures with decreases noted at the higher temperatures. The material showed a strain-rate sensitivity particularly at temperatures in excess of about 538°C due to the presence of what was believed to be strain aging. The tensile-strength data were parameterized in order to permit estimates of changes in both room- and elevated-temperature properties to be made following exposure for prolonged periods in service time. Estimates are given of the changes in yield and tensile strengths following isothermal exposure at several temperatures for 60 years of service. Observations are presented concerning microstructural and microcompositional changes as observed by conventional and transmission, analytical electron microscopy, and quantitative precipitate extraction.

3573 (CONF-921201–3) **Small angle neutron scattering studies of $Ce(Fe_{1-x}Al_x)_2$.** Yang, Y.S. (McMaster Univ., Hamilton, ON (Canada). Dept. of Physics and Astronomy); Gaulin, B.D.; Fernandez-Baca, J.A.; Wignall, G.D.; Ali, N. Oak Ridge National Lab., TN (United States). [1992]. 10p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. From Conference on magnetism and magnetic materials; Houston, TX (United States); 1-4 Dec 1992. Order Number DE93001712. Source: OSTI; NTIS; GPO Dep.

$Ce(Fe_{1-x}A1_x)_2$, with x = 0, 0.06 and 0.14 has been studied by small-angle neutron scattering (SANS) in order to investigate the instability of the ferromagnetic state in the pure material to small mounts of magnetic disorder. The pure material (x = 0) displays a ferromagnetic transition near T_C = 225 K, and more complicated behavior below ~ 100 K. The disordered alloys, x = 0.06 and x = 0.14, display ferromagnetic-like states over relatively narrow temperature ranges, an additional low temperature phase. The ferromagnetic-like state in the x = 0.14 alloys appears to be qualitatively different to that exhibited by the other two. High wavevector-resolution measurements on the x = 0.06 sample indicate that its low temperature ordered phase is ferrimagnetic in origin.

3574 (DOE/ER/14135–1) **An investigation of the effects of history dependent damage in time dependent fracture mechanics, variable load conditions: Progress report, Phase 2.** Brust, F.W.; Krishnaswamy, P.; Majumdar, B.S. Battelle, Columbus, OH (United States). 12 Nov 1992. 18p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG02-90ER14135. Order Number DE93004288. Source: OSTI; NTIS; GPO Dep.

The demands for structural systems to perform reliably under severe temperatures and load conditions continue to increase. These demands will continue with the development of advanced power generation methods and for future aerospace applications. An understanding of the hightemperature creep crack growth process, which is a frequent failure mechanism in these structures, is important. Many investigations which have appeared to date are concerned with creep crack growth which occurs under a constant load and temperature. However, most structural components experience complicated load histories. The history of degradation and damage which accumulates at the crack tip is greatly influenced by these transients. This program aims at gaining an understanding of the history-dependent high temperature failure process through a

combined experimental and analytical effort. Development of a useful predictive methodology fbr characterizing this process is being undertaken.

3575 (DOE/ER/45120–T1) **The calculation of surface orbital energies for specific types of active sites on dispersed metal catalysts.** Augustine, R.L.; Lahanas, K.M.; Cole, F. Seton Hall Univ., South Orange, NJ (United States). Dept. of Chemistry. [1992]. 5p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG02-84ER45120. Order Number DE93002766. Source: OSTI; NTIS; GPO Dep.

An angular overlap calculation has been used to determine the s, p, and d orbital energy levels of the different types of surface sites present on dispersed metal catalysts. These data can permit a Frontier Molecular Orbital treatment of specific site activities as long as the surface orbital availability for overlap with adsorbed substrates is considered along with its energy value and symmetry.

3576 (DOE/ER/45130–7) **Multi-body forces and the energetics of transition metals, alloys, and semiconductors: Annual progress report, (1991–1992).** Carlsson, A.E. Washington Univ., St. Louis, MO (United States). Dept. of Physics. [1992]. 7p. Sponsored by USDOE, Washington, DC (United States); Department of Defense, Washington, DC (United States). DOE Contract FG02-84ER45130. Order Number DE93002230. Source: OSTI; NTIS; INIS; GPO Dep.

Progress over the past year is divided into 3 areas: potential-energy functions for transition-metal aluminides; electronic structure and energetics of complex structures and quasicrystals; and ceramic materials (PdO, PtO).

3577 (DOE/ER/45214–T5) **Twin boundaries, interfaces and modulated structures in martensites: Final report.** Barsch, G.R. Pennsylvania State Univ., University Park, PA (United States). Materials Research Lab.; Cornell Univ., Ithaca, NY (United States). 30 Sep 1992. 26p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG02-85ER45214 ;FG02-88ER45364. Order Number DE93002136. Source: OSTI; NTIS; GPO Dep.

Theoretical studies were pursued with supporting experimental investigations (In-Tl) on the statics, dynamics, and statistical mechanics of twin boundaries, twin bands, and pretransformation structural modulations in proper and improper ferroelastic martensites.

3578 (DOE/ER/45239–8) **[Atomic and electronic structure of metals and alloys: Clean surfaces and chemisorbed molecules].** State Univ. of New York, Stony Brook, NY (United States). Research Foundation. [1993]. 4p. Sponsored by USDOE, Washington, DC (United States); National Science Foundation, Washington, DC (United States). DOE Contract FG02-86ER45239. Order Number DE93004371. Source: OSTI; NTIS; GPO Dep.

Ultrapure Tb was further purified and surface cleaning procedures developed for basal plane and $(11\bar{2}0)$ surface of Tb. Structure of both surfaces was found to be relaxed: (0001) is contracted by 3.9% in the first and expanded by 1.4% in second interlayer spacing; $(11\bar{2}0)$ is contracted by 3.3% in first layer and shows a change in registry. Thin films of Gd, Tb, Dy, Ho, and Er were grown on W{110} substrate in ultrahigh vacuum. Studies have been carried out on epitaxial systems involving Cu, Fe and Mn on Fe and Pt, Cu, and Pd substrates, respectively; new metastable crystalline phases have been found. Studies of possible ferromagnetism in 4d elements (Rh, Ru) and relativistic effects in electron band structure of Cu{111} have been completed and published. Plans for the following year are given.

3579 (DOE/ER/45281–7) **Magnetic multilayer interface anisotropy: Technical progress report, January 1, 1992–December 31, 1992.** Pechan, M.J. Miami Univ., Oxford, OH (United States). [1992]. 7p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG02-86ER45281. Order Number DE93004951. Source: OSTI; NTIS; GPO Dep.

Ni/Mo and Ni/V multilayer magnetic anisotropy has been investigated as a function of Ni layer thickness, frequency and temperature. Variable frequency ferromagnetic resonance (FMR) measurements show, for the first time, significant frequency dependence associated with the multilayer magnetic anisotropy. The thickness dependence allows one to extract the interface contribution from the total anisotropy. Temperature dependent FMR (9 GHz) and room temperature magnetization indicate that strain between Ni and the non-magnetic layers is contributing significantly to the source of the interface anisotropy and the state of the interfacial magnetization. In order to examine the interface properties of other transition metal multilayer systems, investigations on Fe/Cu are underway and CoCr/Ag is being proposed. ESR measurements have been reported on Gd substituted YBaCuO superconductors and a novel quasi-equilibrium method has been developed to determine quickly and precisely the ransition temperature.

3580 (DOE/ER/45295–T2) **Atomistic studies of grain boundaries in alloys and compounds: Progress report, July 1990–October 1992.** Vitek, V. Pennsylvania Univ., Philadelphia, PA (United States). Dept. of Materials Science and Engineering. Oct 1992. 34p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG02-87ER45295. Order Number DE93002769. Source: OSTI; NTIS; GPO Dep.

Atomic structure and atomic level properties of grain boundaries in binary alloys have been studied theoretically. Both ordered and disordered alloys were investigated with the aim responsible for the physical and mechanical properties differing from pure metals. An integral part is atomic interactions. The first are the many-body potentials akin to the embedded atom method. The most important potentials for Cu-Bi which combined empirical data and ab initio electronic structure calculations to construct reliable potentials. LMTO based tight-binding method were developed fully for pure metals with future application alloys. Structural studies were carried out for disordered Cu-Bi and ordered Ni_3Al and Cu_3Au alloys. In the former case the investigation was linked with HREM, and result is solution of structure of $\Sigma = 3$ $(111)/(11\bar{1})$ facets containing Bi formed during segregation from originally curved boundaries. In the latter case, effect of ordering strength and stoichiometry deviations the boundary structure was investigated. The most interesting finding is a very different behavior of Ni rich and Al rich Ni_3Al which may explain why only Ni rich compounds can be ductilized by boron. In both cases the surplus element segregates to the boundaries.

3581 (EGG-FSP–10341) **Oxidation and volatilization of a niobium alloy: Fusion Safety Program/Activation Products Task.** Smolik, G.R.; McCarthy, K.A. EG and G Idaho, Inc., Idaho Falls, ID (United States). Jul 1992. 26p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC07-76ID01570. Order Number DE93001927. Source: OSTI; NTIS; INIS; GPO Dep.

This report presents the findings from a preliminary investigation into oxidation and volatilization characteristics of a niobium alloy. Niobium is a candidate alloy for use in plasma facing components (PFCS) in experimental fusion reactors like the International Thermonuclear Experimental Reactor (ITER). An experimental alloy was tailored to simulate small changes in chemistry which could result from transmutations from irradiation. The alloy was exposed in air and steam between 800°C and 1200°C. Volatilized products and hydrogen were collected and measured. Post-test examinations were also performed on the samples to determine the amount of material loss during the exposures. The obtained measurements of volatilization flux (g/m^2-s), hydrogen generation rates ($liters/m^2$-s), and recession rates (mm/s) are data which can be used for safety analyses and material performance to predict consequences which may result from an accident involving the ingress of air or steam into the plasma chamber of fusion reactor. In our volatility tests, only molybdenum and niobium were found at release levels above the detection limit. Although molybdenum is present at only 0.12 wt%, the quantities of this element volatilized in air are nearly comparable to the quantities of niobium released. The niobium release in steam is only three to four times higher than that of molybdenum in steam. The hydrogen production of the niobium alloy is compared with other PFC materials that we have tested, specifically, beryllium, graphite, and a tunesten alloy. At high temperatures, the hydrogen production rate of the niobium alloy is among the lowest of these materials, significantly lower than beryllium. To understand what this means in an accident situation, modeling is necessary to predict temperatures, and therefore total hydrogen production. The INEL is currently doing this modeling.

3582 (EGG-FSP–10346) **Reaction of porous beryllium in steam: Fusion Safety Program/Activation Products Task.** Smolik, G.R.; Merrill, B.J.; Wallace, R.S. EG and G Idaho, Inc., Idaho Falls, ID (United States). Jul 1992. 15p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC07-76ID01570. Order Number DE93001960. Source: OSTI; NTIS; GPO Dep.

This report presents the findings of some additional investigations into the reaction of beryllium of approximately 88% theoretical density with steam. An earlier investigation had shown this material to be extremely reactive compared to dense beryllium. Inductively heated samples developed self-sustaining reactions due to the exothermic heat of reaction at temperatures between 600°C and 700°C. These initial tests did not completely explain the mechanisms causing this behavior. The onset of thermal instability appeared to have a temperature dependent incubation period and some dependence upon specimen geometry. Additional tests have clarified this behavior. We have also obtained measurements of emissivity and permeability. This information will be helpful in the future in modeling reactor accident scenarios. The high effective surface area of porous beryllium has also allowed reaction rates to be obtained at temperatures as low as 400°C. This information for porous beryllium was then used to extend relationships for the reaction rates of dense beryllium in steam to these lower temperatures.

3583 (ENEL-CRTN-G11–90-07) **Pre-oxidation effect on corrosion-fatigue behaviour of 106 Gr. C steel.** Gabetta, G.; Rubio, J.E.; Torri, L.; Bregani, F.; Ragazzoni, S. Ente Nazionale per l'Energia Elettrica, Milan (Italy). Centro Termica e Nucleare; Centro Informazioni Studi Esperienze (CISE), Milan (Italy). 1990. 14p. (In Italian). (CONF-9009489–2: Convegno nazionale AIM, Ancona (Italy), 25-27 Sep 1990). Order Number DE93729408. Source: OSTI; NTIS (US Sales Only).

The corrosion-fatigue and stress corrosion cracking (SCC) behaviour of materials for fossil fuel power plant components is being studied at CISE research labs within the framework of an ENEL (Italian Electricity Board)-CRTN research program. Corrosion-fatigue and SCC tests are being run in service simulated environments on pre-oxidized specimens with the aim of assessing the influence of the surface oxide layer on the crack nucleation mechanism. Preliminary results indicate that the oxide layer markedly accelerates the crack nucleation phase of both corrosion-fatigue and stress corrosion cracks.

3584 (ENEL-CRTN-T11–91-10) **Nucleation and growth of corrosion pits in turbine blades.** Torri, L.; Gabetta, G.; Bregani, F.; Ragazzoni, S. Ente Nazionale per l'Energia Elettrica, Milan (Italy). Centro Termica e Nucleare; Centro Informazioni Studi Esperienze (CISE), Milan (Italy). 1991. 13p. (In Italian). (CONF-9106351–4: 7. convegno nazionale Gruppo Italiano Frattura (IGF), Florence (Italy), 13-14 Jun 1991). Order Number DE93729440. Source: OSTI; NTIS (US Sales Only).

Stress corrosion cracking and corrosion fatigue in 12% Cr steel in sodium chloride solution was investigated through tests performed both in air at room temperature and in aqueous solution with 22% NaCl at 80 degrees C. Particular attention was given to the influence of corrosion pits on crack nucleation. The delta K value for crack nucleation from corrosion pits in rotating bending fatigue tests, in air, was very low (about 3 MPa radical m). On fracture surfaces tested in the 22% NaCl solution, crack initiation was observed in relation to corrosion pits; in this case, fatigue life could be described using a fracture mechanics approach. The results of SSRT on smooth specimens showed that there exists a threshold stress intensity of about 15 MPa radical m and a plateau of stress corrosion crack growth rate of about $1*10^{-5}$mm-s.

3585 (ENEL-CRTN-T11–92-02) **Protective effect of coatings on corrosion behaviour of Ni based superalloys in gas turbine atmospheres.** Coen Porisini, F.; Saiu, R.; Dos Santos Marquez, F.; Bregani, F. Ente Nazionale per l'Energia Elettrica, Milan (Italy). Centro Termica e Nucleare. Jan 1992. 16p. (CONF-920517–1: 3. international symposium on high temperature corrosion and protection of materials - 180. event of the European Federation of Corrosion, Les Embiez (France), 25-29 May 1992). Order Number DE93729399. Source: OSTI; NTIS (US Sales Only).

The corrosion of Ni based superalloys IN 738, IN 792, UD 720 and MA 6000 in gaseous atmospheres were studied at three temperatures: 800 degrees C, 950 degrees C and 1100 degrees C. The corrosive atmospheres, simulating the composition of combustion gases of turbines, were highly oxidizing (Ar + 10% O_2) and contained low amounts of SO_2. The effect of an anticorrosive coating, of the type MCrAlY, was studied in corrosion tests of coated and uncoated specimens. Weight change measurements, together with SEM analysis were used to determine the extent and morphology of the corrosion. The effect of the MCrAlr coating was to reduce the extent of the corrosion due to the formation of a protective Al_2O_3 layer.

3586 (ETDE-IT–92-91) **Behaviour of OFHC copper in highly pure water.** Perboni, G.; Rocchini, G.; Brunoro, G.; Trabanelli, G. Ente Nazionale per l'Energia Elettrica, Milan (Italy). Centro Termica e Nucleare; Ferrara Univ. (Italy). 1991. 14p. (In Italian). (CONF-900487–1: 11. international corrosion congress: innovation and technology transfer for corrosion control and the 159th event of the European Federation of Corrosion, Florence (Italy), 2-6 Apr 1990). Order Number DE93729479. Source: OSTI; NTIS (US Sales Only); INIS.

In order to gain a wider knowledge of corrosion phenomena in OFHC (oxygen free high conductivity) copper pipes of the stator cooling circuit of a power plant turboalternator, a research program was laid out which is based on the use of an experimental loop simulating real operating conditions as closely as possible. The samples examined were either copper foils or hollow conductors of the type that is normally used in the stator cooling system, and the circulating fluid was high purity water with controlled O_2, H_2 and $C0_2$ contents. Investigations were focused on the kinetics of O_2 removal through catalytic resins covered with metallic palladium (at different temperatures and pressures) and on the kinetics of CO_2 removal through mixed bed resins. Subsequently, attention was directed to the corrosion of copper (in the form of foils or hollow conductors) under different experimental conditions simulating either optimal or anomalous situations that can occur in the operation of an industrial plant.

3587 (GKSS–91/E/92) **Reaction HIP process for titanium-aluminide alloys.** Dahms, M.; Dogan, B.; Smarsly, W.; Wang, G.X. GKSS-Forschungszentrum Geesthacht GmbH, Geesthacht-Tesperhude (Germany). 1991. 16p. (CONF-9111271–: International conference on powder metallurgy (PM) aerospace materials (PM AERO '91), Lausanne (Switzerland), 4-6 Nov 1991). Order Number DE93728732. Source: OSTI; NTIS (US Sales Only); INIS.

Titanium-aluminide can be produced by reactive hot isostatic pressing (RHIP) of cold extruded titanium-aluminium elemental powder mixtures. The Kirkendall porosity to be closed by HIP is considerably less than the porosity of simply reacted powder compacts. Additional cold working of the extruded rod is possible such that sheets and foils can easily be produced. Various RHIP temperatures as well as additional heat treatments can be applied in order to produce different microstructures. Tensile tests show that RHIP material is more brittle than cast and forged material. Although the oxygen content of the material is considerably high, some ductility can be obtained by optimizing the microstructure. The fracture mode is mainly brittle at all temperatures. Increased measured elongation at high temperature is attributed to manily microcracking of TiAl as well as increased dislocation density and twinning. (orig.) With 9 figs., 1 tab.

3588 (IC–92/204) **Effective interactions between concentration fluctuations and charge transfer in chemically ordering liquid alloys.** Akdeniz, Z.; Tosi, M.P. International Centre for Theoretical Physics, Trieste (Italy). Aug 1992. 10p. Order Number DE93606724. Source: OSTI; NTIS (US Sales Only); INIS.

The correlations between long-wavelength fluctuations of concentration in a liquid binary alloy are determined by a balance between an elastic strain free energy and an Ornstein-Zernike effective interaction. The latter is extracted from thermodynamic data in the case of the Li-Pb system, which is well known to chemically order with stoichiometric composition corresponding to Li_4Pb. Strong attractive interactions between concentration fluctuations near the composition of chemical ordering originate from electronic charge transfer,

which is estimated from the electron-ion partial structure factors as functions of composition in the liquid alloy. (author). 20 refs, 2 figs.

3589 (IC–92/205) **Local order and concentration fluctuations in K-Pb and Rb-Pb alloys.** Akinlade, O. International Centre for Theoretical Physics, Trieste (Italy). Aug 1992. 21p. Order Number DE93606725. Source: OSTI; NTIS (US Sales Only); INIS.

The concentration fluctuations in the long wavelength limit $S_{cc}(0)$, short range order parameter and free energy of mixing of K-Pb and Rb-Fb alloys have been studied within the framework of the quasi-chemical theory. It is observed that the simple model could be used to shed more insight into the nature of chemical ordering that exists in such strongly compound forming binary alloys. (author). 19 refs, 6 figs, 1 tab.

3590 (INIS-BR–2953) **Determination of the crystallite orientation distribution from direct pole figures.** Araujo Gomes, P.A.M. de. Universidade Federal, Rio de Janeiro, RJ (Brazil). Coordenacao dos Programas de Pos-graduacao de Engenharia. 1977 130p. (In Portuguese). Order Number DE93606708. Source: OSTI; NTIS (US Sales Only); INIS.

A method is described which allows to calculate the crystallite orientation distribution in polycrystalline material, from direct pole figures data of its crystallographic planes (Roe's Method). The programme was applied to (1010), (0002), (1011) and (1120) complete pole figures data for a commercial, thin sheet Zircaloy-4 tubing specimen. A semi-automatic Rigaku-Denki texture goniometer, which scans the reciprocal lattice sphere pointwise outputting the data in a punched tape, was used to obtain the pole figures. This is consistent with the results obtained through direct conclusion from the pole figures. (author).

3591 (INIS-BR–2955) **Anodic behaviour of the stainless steel AISI 430 in aqueous solutions of chloride and sulphate ions.** Sebrao, M.Z. Universidade Federal, Rio de Janeiro, RJ (Brazil). Coordenacao dos Programas de Pos-graduacao de Engenharia. 1982 111p. (In Portuguese). Order Number DE93606738. Source: OSTI; NTIS (US Sales Only); INIS.

The kinetics of the dissolution of stainless steel AISI 430 in the presence of chloride and sulphate ions has been studied in terms of the ion concentration, the pH variation, and the velocity of the working electrode. The experimental method utilized was the potentiostatic anodic polarization, and the reactants used were NaCl and $Na_2 SO_4$ at room temperature. Atomic Absorption spectrophotometry and Auger Electrons spectroscopy (AES) analyses were made in order to support the interpretation of results obtained by means of the potentiostatic polarization method. (author).

3592 (INIS-BR–2985) **Study of the experimental parameters associated to the determination of residual macro stresses in stainless steel tubes through x-rays diffraction method.** Guimaraes, L.R. Instituto de Pesquisas Energeticas e Nucleares (IPEN), Sao Paulo, SP (Brazil). 1990 92p. (In Portuguese). Order Number DE93606716. Source: OSTI; NTIS (US Sales Only); INIS.

The basic principles related to the determination of residual macro stresses by X-rays diffractometry are present, whereas different techniques associated with the respective experimental errors are discussed. The residual stresses in two 304 L stainless steel tubes were measured using three models of diffractometers, Rigaku SG-8, Jeol JDX-11PA and Rigaku Strainflex. The measured values of stresses as well as the reproducibilities are examined. The suitability of peak location method, by fitting three data points to the parabolic function, is discussed through values of position and intensity obtained by two of the above diffractometers. (author).

3593 (INIS-BR–3041) **Study on the dimensional instability of metallic uranium subject to thermal alternation.** Gentile, E.F. Sao Paulo Univ., SP (Brazil). Escola Politecnica. 1970 53p. (In Portuguese). Order Number DE93606709. Source: OSTI; NTIS (US Sales Only); INIS.

The study of the dimensional instability of metallic uranium subject to thermal alternation. It discusses mainly its physical properties is described. (A.C.A.S.).

3594 (INIS-BR–3048) **Analysis of microstructure constitution and electrochemical characteristics of pitting corrosion in AISI 316-L type stainless steel modified by niobium.** Assis, O.B.G. de. Sao Paulo Univ., Sao Carlos, SP (Brazil). Escola de Engenharia. 1986 94p. (In Portuguese). Order Number DE93606710. Source: OSTI; NTIS (US Sales Only); INIS.

The viability of total or partial substitution of molybdenum by niobium in stainless steel type AISI 316-L was studied. It was analysed the effects caused on the microstructural constitution and the electrochemical characteristics in the formation and stability of superficial oxide films grown on acid chloride solution. The electrochemical parameters were obtained on the potential kinetic polarization curves for two different scanning rates, as well the alloys dissolution rate by the measure of the variation in pitting density current (I_p) on time at a constant potential of + 300 mV (ECS). It was established the characteristics of niobium as stabilizer element of the passive film through inhibition of pitting propagation by the formation of re passivation oxides in the broken sites or actives points in the film. (author).

3595 (JINR-R–2-91-241) **Mathematical simulation of the induced γ-radiation in structural materials of spaceships.** Barashenkov, V.S. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Computing Techniques and Automation); Sosnin, A.N.; Taranenko, P.I.; Fedotov, S.N. Joint Inst. for Nuclear Research, Dubna (Russian Federation). Lab. of Computing Techniques and Automation. 1991. 7p. (In Russian). Order Number DE93606751. Source: OSTI; NTIS (US Sales Only); INIS.

A Monte-Carlo model of internuclear cascades, supplemented with a programme calculating the gamma-radiation spectra, emitted by excited aftercascade nuclei is used to investigate characteristics of induced gamma-activity in structural materials Al, Ti, Fe, W, Pb and in one of the alloys exposed to the influence of cosmic particles and albedo neutrons on close-to-earth orbits. Spectral distributions of activational gamma-radiation are calculated. It is shown that the induced radioactivity is comparable and in some of the energy intervals even exceeds the background gamma-radiation on the orbit. 18 refs.; 5 figs.

3596 (KAERI/RR–1072/91) **A study on proton irradiation effects on nuclear materials using cyclotron.** Kang, Young Hwan (Korea Atomic Energy Research Inst., Daeduk (Korea, Republic of)); Chi, Se Hwan; Park, Deuk Keun; Han, Dae June; Kim, Dae Hwan; Kim, Sung Soo; Oh, Jong Myung; Lee, Bong Sang. Korea Atomic Energy Research Inst., Daeduk (Korea, Republic of). Jan 1991. 82p. (In Korean). Order Number DE93605682. Source: OSTI; NTIS (US Sales Only); INIS.

Understanding on radiation damage mechanism of important structural materials is important for safe operation and radiation damage evaluation of new reactor structural materials. This study was performed to simulate and evaluate 14 MeV neutron irradiation effects on a candidate structural material (HT-9) of next generation reactors(FBR,fusion) by cyclotron(MC-50MeV) accelerated 16MeV protons. Produced defects type and its thermal behavior were analyzed by recovery activation energy and order of reaction which were determined by Meechan and Brinkman method. Defects were believed to be vacancy type and interstitial hydrogens that have low recovery activation energies. (Author).

3597 (KIYaI–91-9) **Electron-microscopic investigations of irradiated and naturally aged aluminium alloy.** Drobyazin, V.N.; Polovneva, S.P.; Podzirej, Yu.S.; Soldatenko, G.A. AN Ukrainskoj SSR, Kiev (Ukraine). Inst. Yadernykh Issledovanij. 1991. 9p. (In Russian). Order Number DE93606752. Source: OSTI; NTIS (US Sales Only); INIS.

The decay kinetics of solid solution, irradiated and naturally aged alloy of Al-Cu-Mg-Mn system was investigated by the method of transmission electron microscopy. It was shown that in irradiated and natural aged alloy the decay of solid solution proceeds in other mechanism than in non-irradiated one. As a result of irradiation the multilayer dislocation loops of interstitial nature, which serves as discharges for impurity atoms and the centre of metastable phase S' and Θ'. It was shown that it promotes to form the more homogeneous and uniform structure of alloy that in one's turn improve the mechanical alloy properties. 11 refs.; 2 figs.

3598 (LA–12397-T) **A contact area evolution model for friction in metal forming.** Korzekwa, D.A. Los Alamos National

Lab., NM (United States). Sep 1992. 123p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. Order Number DE93001902. Source: OSTI; NTIS; GPO Dep.

A model was developed that describes the evolution of the fraction of the area in boundary contact at the tool-workpiece interface during metal forming, such as sheet metal forming. An experiment that simulates the in-plane drawing deformation, as in the deep drawing of sheet metal, was designed for roughness changes during sheet forming. The model was developed by solving a surface indentation problem that approximates the flattening of asperities, and results are expressed as a relation between nondimensional variables. Rate of change in the contact area can be calculated from the normal pressure on an asperity, current contact area fraction and strain rate components in the underlying workpiece material. A 304L stainless steel sheet was used in the experiments. Sheet specimens were produced, and contact area fraction was estimated from profiles on the surface. The original surface profile and measured strain and pressure histories were used as inputs to the model, and contact area fractions were calculated. Experiments generally support the model, in that large changes in contact area fraction are observed, and the effects of pressure and work-piece strain rate follow the predicted trends. A large effect of straining direction is observed, as predicted by the model. It is noted that the inhomogeneous deformation of grains at the surface results in roughness changes that are comparable in magnitude and length scale to the flattening process described by the model. 36 refs, 6 tabs, 64 figs.

3599 (LA-UR–92-2701) **Crystallographic and magnetic properties of UPdSn.** Johnson, S.W. (Los Alamos National Lab., NM (United States)); Robinson, R.A.; Larson, A.C.; Nakotte, H.; Brueck, E.; de Boer, F.R. Los Alamos National Lab., NM (United States). [1992]. 12p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. (CONF-921201–1: Conference on magnetism and magnetic materials, Houston, TX (United States), 1-4 Dec 1992). Order Number DE92040243. Source: OSTI; NTIS; INIS; GPO Dep.

A single crystal of the intermetallic compound UPdSn has been studied by means of neutron diffraction using the white-beam Laue diffractometer SCD at the Los Alamos spallation neutron source. Data were taken in the paramagnetic phase at 55K and just below the Neel point at 37K. The crystallographic data refine well within the space group $P6_3mc$ and confirm the results obtained previously on powders, namely that the Pd and Sn atoms are ordered. At low temperature, UPdSn undergoes two phase transitions at 40K and 25K to complicated non-collinear antiferromagnetic structures. All three pairs of magnetic domains are observed, in roughly equal populations, in the intermediate-temperature orthorhombic magnetic structure (Phase 1). We obtain a uranium moment of 0.863 μ_B and canting angles $\phi = 57.52°$ and $\phi = 18.63°$, in reasonable agreement with previous powder neutron data for this temperature. The observed form factor is characteristic of the tetravalent f^2 configuration.

3600 (LBL–32829) **Electronic structure of substitutionally disordered alloys: Direct configurational averaging.** Wolverton, C.; de Fontaine, D.; Dreysse, H.; Ceder, G. Lawrence Berkeley Lab., CA (United States). Apr 1992. 10p. Sponsored by USDOE, Washington, DC (United States); North Atlantic Treaty Organization, Brussels (Belgium); National Science Foundation, Washington, DC (United States). DOE Contract AC03-76SF00098. Grant 0512/88;Grant INT-8815493. (CONF-920402–65: 1992 Material Research Society (MRS) spring meeting, San Francisco, CA (United States), 27 Apr - 2 may 1992). Order Number DE93002548. Source: OSTI; NTIS; GPO Dep.

The method of direct configurational averaging (DCA) has been proposed to study the electronic structure of disordered alloys. Local density of states and band structure energies are obtained by averaging over a small number of configrations within a tight-binding Hamiltonian. Effective cluster interactions, the driving quantities for ordering in solids, are computed for various alloys using a tight-binding form of the linearized muffin-tin orbital method (TB-LMTO). The DCA calculations are used to determine various energetic and thermodynamic quantities for binary and ternasy alloys. (Pd, Rh, V).

3601 (LBL–32830) **A first-principles study of the phase stability of fcc-based Ti-Al alloys.** Asta, M. (California Univ., Berkeley, CA (United States). Dept. of Materials Science and Mineral Engineering); de Fontaine, D.; van Schilfgaarde, M.; Sluiter, M.; Methfessel, M. Lawrence Berkeley Lab., CA (United States). Apr 1992. 9p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC03-76SF00098. (CONF-920402–62: 1992 Material Research Society (MRS) spring meeting, San Francisco, CA (United States), 27 Apr - 2 may 1992). Order Number DE93002549. Source: OSTI; NTIS; GPO Dep.

In this paper we present results of a first-principles phase stability study of fcc-based Ti-Al alloys. In particular the full-potential linear muffin tin orbital method has been used to determine heats of format on and other zero-temperature properties of 9 fcc ordered superstructures as well as fcc and hcp Ti, and fcc Al. From these results a set of effective cluster interactions are determined which are used in a cluster variation method calculation of the thermodynamic properties and the composition-temperature phase diagram of fcc-based alloys.

3602 (NSS-R–280) **Stainless steel waste containers: an assessment of the probability of stress corrosion cracking.** Wanklyn, J.N. (AEA Industrial Technology, Harwell (United Kingdom)); Naish, C.C. United Kingdom Nirex Ltd., Harwell (United Kingdom). Jun 1991. 24p. Order Number DE93606739. Source: OSTI; NTIS (US Sales Only); INIS.

The paper summarises information obtained from the literature and discussions held with corrosion experts from universities and industry, relevant to the possibility that stainless steel radioactive waste containers containing low level and intermediate level radioactive waste (LLW and ILW) could, when buried in concrete, suffer one or more of the forms of stress corrosion cracking (SCC). Stress corrosion cracking is caused by the simultaneous and synergistic action of a corrosive environment and stress. The initiation and propagation of SCC depend on a number of factors being present, namely a certain level of stress, an environment which will cause cracking and a susceptible metal or alloy. Generally the susceptibility of a metal or alloy to SCC increases as its strength level increases. The susceptibility in a specific environment will depend on: solution concentration, pH, temperature, and electrochemical potential of the metal/alloy. It is concluded that alkaline stress corrosion cracking is unlikely to occur under even the worst case conditions, that chloride stress corrosion cracking is a distinct possibility at the higher end of the temperature range (25-80°C) and that stress corrosion related to sensitization of the steel will not be a problem for the majority of container material which is less than 5 mm in cross section. Thicker section material could become sensitized leading to a local problem in these areas. Contact with metals that are electrochemically more negative in corrosion potential is likely to reduce the incidence of SCC, at least locally. Measurement of repassivation potentials and rest potentials in solutions of relevant composition would provide a firmer prediction of the extent to which a high pH could reduce the likelihood of SCC caused by chlorides. (author).

3603 (NUREG/GR–0001) **Quantitative measurement and modeling of sensitization development in stainless steel.** Bruemmer, S.M. (Pacific Northwest Lab., Richland, WA (United States)); Atteridge, D.G. Nuclear Regulatory Commission, Washington, DC (United States). Div. of Engineering; Oregon Graduate Inst. of Science and Technology, Beaverton, OR (United States). Dept. of Materials Science and Engineering. Sep 1992. 206p. Sponsored by Nuclear Regulatory Commission, Washington, DC (United States). Source: OSTI; NTIS; INIS; GPO.

The state-of-the-art to quantitatively measure and model sensitization development in austenitic stainless steels is assessed and critically analyzed. A modeling capability is evolved and validated using a diverse experimental data base. Quantitative predictions are demonstrated for simple and complex thermal and thermomechanical treatments. Commercial stainless steel heats ranging from high-carbon Type 304 and 316 to low-carbon Type 304L and 316L have been examined including many heats which correspond to extra-low-carbon, nuclear-grade compositions. Within certain limits the electrochemical potentiokinetic reactivation (EPR) test was

found to give accurate and reproducible measurements of the degree of sensitization (DOS) in Type 304 and 316 stainless steels. EPR test results are used to develop the quantitative data base and evolve/validate the quantitative modeling capability. This thesis represents a first step to evolve methods for the quantitative assessment of structural reliability in stainless steel components and weldments. Assessments will be based on component-specific information concerning material characteristics, fabrication history and service exposure. Methods will enable fabrication (e.g., welding and repair welding) procedures and material aging effects to be evaluated and ensure adequate cracking resistance during the service lifetime of reactor components. This work is being conducted by the Oregon Graduate Institute with interactive input from personnel at Pacific Northwest Laboratory.

3604 **Magnetron sputtered boron films and Ti/B multilayer structures.** Makowiecki, D.M.; Jankowski, A.F. To Dept. of Energy. 11 Mar 1991. USAA patent application 7-666,97. 20p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. Order Number DE93002022. Source: OSTI; NTIS; GPO Dep.

A method is described for the production of thin boron and titanium/boron films by magnetron sputter deposition. The amorphous boron films contain no morphological growth features, unlike those found when thin films are prepared by various physical vapor 5 deposition processes. Magnetron sputter deposition method requires the use of a high density crystalline boron sputter target which is prepared by hot isostatic pressing. Thin boron films prepared by this method are useful for ultra-thin band pass filters as well as the low Z element in low Z/high Z mirrors which enhance reflectivity 10 from grazing to normal incidence.

3605 (SAND–92-1958C) **Characterization of solidification and weldability of Fe-29Ni-17Co alloys.** Robino, C.V.; Hills, C.R.; Hlava, P.F. Sandia National Labs., Albuquerque, NM (United States). [1992]. 21p. Sponsored by USDOE, Washington, DC (United States). (CONF-921109–2: Fall meeting of the Metallurgical Society and American Institute Metallurgical and Petroleum Engineers, Chicago, IL (United States), 1-5 Nov 1992). Order Number DE93000739. Source: OSTI; NTIS; GPO Dep.

Applications for the controlled thermal expansion alloy Fe-29Ni-17Co often require joining by fusion welding processes. In addition, these applications usually require hermetic and high reliability joints. The small size of typical components normally dictates the use of autogenous welding processes, so that the hot cracking tendency of Fe-29Ni-17Co is of concern. The solidification behavoir and hot cracking tendency of commercial Fe-29Ni-17Co has been evaluated using diffcrential thermal analysis (DTA), Varestraint testing, light and electron microscopy, and laser welding trials. DTA and microstructural analysis indicated that the solidification of Fe-29Ni-17Co occurs as single phase austenite, does not exhibit the formation of terminal solidification phases, and results in only minimal segregation of major alloying elements. Varestraitit testing indicated that the hot cracking behavior of Fe-29Ni-17Co is similar to, though somewhat more pronounced than, 304L and 316 stainless steels. Relative to other Fe-Ni-Co and Ni-based alloys, however, the hot cracking response of this alloy is fiverable. Pulsed laser welding trials indicated that the phosphorus and sulfur levels in this heat of Fe-29Ni-17Co were insufficient to pmmote cracking in bead-on-plate welds.

3606 (TVA-Bull–Z-311) **Slow strain rate fracture of high-strength steel at controlled electrochemical potentials in ammonium chloride, potassium chloride, and ammonium nitrate solutions.** Nguyen, D.T. (National Fertilizer and Environmental Research Center, Muscle Shoals, AL (United States)); Nichols, D.E.; Daniels, R.D. National Fertilizer and Environmental Research Center, Muscle Shoals, AL (United States). 15 Aug 1992. 26p. Sponsored by Tennessee Valley Authority, Knoxville, TN (United States). (CONF-920815–11: 204. American Chemical Society (ACS) national meeting, Washington, DC (United States), 23-28 Aug 1992). Order Number DE93002586. Source: OSTI; NTIS.

Slow strain rate testing has been undertaken to determine the effects of individual chemical species on the fracture process of high-strength 4340 steel. Test environments included potassium chloride, ammonium nitrate, and ammonium chloride at concentrations from 0.001 to 1.0 mole por liter at ambient temperature. Tests were performed at cathodic and anodic controlled potentials, as well as at the open-circuit potential, to delineate the stress corrosion cracking range.

3607 (UCRL-JC–108837) **Magnetic circular dichroism in x-ray absorption and core-level photoemission of Fe/Cu(001).** Tobin, J.G. (Lawrence Livermore National Lab., CA (United States)); Waddill, G.D.; Pappas, D.P. Lawrence Livermore National Lab., CA (United States). Jul 1992. 4p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. (CONF-920735–4: 10. international conference on vacuum ultraviolet radiation physics, Paris (France), 27-31 Jul 1992). Order Number DE93001305. Source: OSTI; NTIS; GPO Dep.

We report the first observation of magnetic circular dichroism in both x-ray absorption and core-level photoemission of ultra thin magnetic films using circularly polarized x-rays. Iron films (1–4 ML) grown on a Cu(001,) substrate at 150 K and magnetized perpendicular to the surface show dramatic changes in the $L_{2,3}$ branching ratio for different x-ray polarizations. For linearly-polarized x-rays perpendicular to the magnetic axis of the sample the branching ratio was 0.75. For films $\geq$ 2 ML, this ratio varied from 0.64 to 0.85 for photon spin parallel and anti-parallel, respectively, to the magnetic axis. This effect was observed either by changing the x-ray helcity for a fixed magnetic axis, or by reversing the magnetic axis for a fixed x-ray helicity. Our observation can be analyzed within a simple one-electron picture, if the raw branching ratios are normalized so that the linear value becomes statistical. Furthermore, warming the films to $\sim$ 300 K eliminated this effect, indicating a loss of magnetization in the film over a temperature range of $\sim$ 30 K. Finally, reversing the relative orientation of the photon spin and the magnetic axis from parallel to anti-parallel allowed measurement of the exchange splitting of the Fe 2p core levels which was found to be $\sim$ 0.2 eV. These results are consistent with earlier studies, but the use of off-plane circularly-polarized x-rays from a bending magnet monochromator offers $\sim$ 2 orders of magnitude greater intensity than typical spin-polarization measurements.

3608 (UCRL-JC–111359) **HRTEM observations of modulated structures in Ti-Pd-Cr β_2 alloys.** Schwartz, A.J.; Tanner, L.E. Lawrence Livermore National Lab., CA (United States). Aug 1992. 6p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. (CONF-920722–4: International conference on martensitic transformations, Monterey, CA (United States), 20-24 Jul 1992). Order Number DE93001507. Source: OSTI; NTIS; GPO Dep.

Conventional and high-resolution transmission electron microscopy (HRTEM) and electron diffraction (ED) have been used to examine a series of $Ti_{50}Pd_{50-x}Cr_x\beta_2$ (B2, CsCl-type crystal structure) alloys with x between 6 and 10 at.% in order to determine the nature of the modulated structures that develop on cooling. The ED and HRTEM results reveal that the modulation periodicity (inverse of the satellite spacing) varies from three $(110)_{B2}$ planes in the 6 at.% Cr alloy to four $(110)_{B2}$ planes for the 10 at.% alloy. Over the same composition range, the "monoclinic angle" (defined between $(200)_{B2}$and $(020)_{B2}$ reflections) is found to increase linearly from 88 to 90°. It is suggested that these effects are associated with the substitution of Cr for Pd that gives rise to an electronically driven $(110)_q<110>_\epsilon$ phonon anomaly.

3609 (WSRC-MS–90-104) **Effect of oxide particle distribution on the helium-induced fracture of copper.** Wheeler, D.A. Westinghouse Savannah River Co., Aiken, SC (United States). [1990]. 27p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC09-89SR18035. (CONF-901008–16: Fall meeting of the Minerals, Metals and Materials Society (TMS), Detroit, MI (United States), 7-11 Oct 1990). Order Number DE93000470. Source: OSTI; NTIS; GPO Dep.

Long-term exposure to tritium (H^3) gas can degrade the mechanical properties of copper alloys while similar exposure to protium (H^1) gas does not cause such degradation. This difference in behavior is attributed to the presence of helium which is generated by the radioactive decay of tritium. The accumulation of helium, which is virtually insoluble in the copper lattice, can cause the nucleation

of cavities along grain boundaries and promote intergranular fracture. Permeation studies have shown that oxide particles act as trap sites for diffusing hydrogen isotopes, and thus may affect the susceptibility of copper to helium-induced degradation by altering the initial tritium distribution in the metal lattice. Tensile and metallographic data demonstrate that oxide particles trap both tritium and helium and decrease the susceptibility of copper to helium-induced intergranular fracture. 25 refs, 3 tabs, 12 figs.

3610 (Y/DV–1153/R1) **Microindentation hardness evaluation of iridium alloy clad vent set cups.** Ulrich, G.B.; DeRoos, L.F.; Stinnette, S.E. Oak Ridge Y-12 Plant, TN (United States). 15 May 1992. 10p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OS21400. (CONF-930103–4: 10. symposium on space nuclear power and propulsion, Albuquerque, NM (United States), 10-14 Jan 1993). Order Number DE92018246. Source: OSTI; NTIS; INIS; GPO Dep.

An iridium alloy, DOP-26, is used as cladding for $^{238}PuO^2$ fuel in radioisotope heat sources for space power systems. Presently, DOP-26 iridium alloy clad vent sets (CVS) are being manufactured at the Oak Ridge Y-12 Plant for potential use in the National Aeronautics and Space Administration's Cassini mission to Saturn. Wrought/ground/stress relieved blanks are warm formed into CVS cups. These cups are then annealed to recrystallize the material for subsequent fabrication/assembly operations as well as for final use. One of the cup manufacturing certification requirements is to test for Vickers microindentation hardness. New microindentation hardness specification limits, 210 to 310 HV, have been established for a test load of 1000 grams-force (gf). The original specification limits, 250 to 350 HV, were for 200 gf testing. The primary reason for switching to a higher test load was to reduce variability in the test data. The DOP-26 alloy exhibits microindentation hardness load dependence, therefore, new limits were needed for 1000 gf testing. The new limits were established by testing material from 15 CVS cups using 200 gf and 1000 gf loads and then statistically analyzing the data. Additional work using a Knoop indenter and a 10 gf load indicated that the DOP-26 alloy grain boundaries have higher hardnesses than the grain interiors.

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Refer also to citation(s) 2553, 3061, 3448, 3553, 3568, 3576, 3579, 3767, 4466, 4699

3611 (ANL/CP–76346) **Microstructure/mechanical-property relationships and R-curve behavior in Si_3N_4/Si_3N_4(w) composites.** Singh, J.P.; Chu, C.Y.; Murphy, C.; Singh, D. Argonne National Lab., IL (United States). Jun 1992. 17p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-31109-ENG-38. (CONF-9210175–1: 24. international Society for the Advancement of Material and Process Engineering (SAMPE) technical conference, Toronto (Canada), 20-22 Oct 1992). Order Number DE92041096. Source: OSTI; NTIS; GPO Dep.

Fracture toughness of Si_3N_4-whisker-reinforced Si_3N_4-matrix composites were evaluated with various whisker contents. Toughness was observed to increase with increasing whisker content, reaching a maximum value of 8.8 $MPa\sqrt{}4$ at 5 vol.% whisker content. Additional whisker content caused reduced toughness. A model based on microstructural features indicates that the observed dependence of toughness on whisker content is due to both whisker-toughening and matrix-grain-size effects. Composites with 5 vol.% whisker content showed a rising crack growth resistance (R-curve) behavior. This is believed to be a combined effect of crack bridging and crack deflection due to both elongated grains and reinforcing whiskers.

3612 (ANL/CP–77482) **Flux pinning by 211 precipitates in melt-processed $YBa_2Cu_3O_x$.** Shi, D.; Sengupta, S.; Smith, M.; Wang, Z.; Biondo, A.C.; Balachandran, U.; Goretta, K.C. Argonne National Lab., IL (United States). Aug 1992. 4p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-31109-ENG-38 ;FG02-90ER45427. (CONF-920802–25: Applied superconductivity conference, Chicago, IL (United States), 23-28 Aug 1992). Order Number DE93001483. Source: OSTI; NTIS; GPO Dep.

Magnetic hysteresis data have been taken at 4.2 and 50 K over a wide range of magnetic fields on melt-textured (MT) and quench-melt-growth-processed (QMGP) $YBa_2Cu_3O_x$ samples with 6 vol.% Of Y_2BaCuO_x (211). In order to obtain accurate comparisons of the intragranular critical current densities, the magnetization measurements were performed on finely powdered samples, the average particle size of which was less than the grain size of the original sample. The QMGP samples exhibited substantially larger hysteresis, indicating significantly enhanced flux pinning at these temperatures. At 4.2 K and 5 T, J_c increase from 4×10^4 A/cm_2 in the MT sample to 5.5×10^5 A/cm^2 in the QMGP sample. A possible pinning mechanism related to the observed hysteretic behavior is discussed.

3613 (BNL–47934) **Electronic structure and fermiology of high temperature superconductors: Theoretical summary.** Emery, V.J. Brookhaven National Lab., Upton, NY (United States). [1992]. 3p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC02-76CH00016. (CONF-9207160–1: United States-Japan seminar on electronic structure and fermiology of high-Tc superconductors, Sendai (Japan), Jul 1992). Order Number DE93001443. Source: OSTI; NTIS; GPO Dep.

This is a summary of theoretical issues raised at the conference on Electronic Structure and Fermiology of High Temperature Superconductors in the context of the more general question of the role of electron correlations.

3614 (CONF-920916–2) **Properties of aligned $YBa_2Cu_3O_{7-\delta}$ superconductor as a function of oxygen deficiency δ.** Ossandon, J.G. (Talca Univ. (Chile). Faculty of Natural Resources); Thompson, J.R.; Christen, D.K.; Sales, B.C.; Kerchner, H.R.; Sun, Y.R.; Tkaczyk, J.E. Oak Ridge National Lab., TN (United States). [1992]. 10p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. From 3. international conference and exhibition of the world congress on superconductivity; Munich (Germany); 14-19 Sep 1992. Order Number DE93001707. Source: OSTI; NTIS; INIS; GPO Dep.

Systematic studies of flux pinning and intragrain critical current J_c were conducted in magnetically aligned, sintered $Y_1Ba_2Cu_3O_{7-\delta}$ material as a function of oxygen deficiency δ in the range $0 \sim 0.2$. The essential findings are: (1) maximum J_c occurred at full oxygenation, i.e., J_c and pinning decreased steadily as oxygen was removed; (2) the irreversibility line $B_{irr}(T,\delta)$ was degraded with the introduction of oxygen defects; (3) this degradation was strongly correlated with the reduction of $J_c(\delta)$, implying that the irreversibility line is determined by the strength of the flux pinning defects; (4) the condensation energy F_c decreased significantly with δ, indicating a rapid weakening in the effectiveness of pre-existing pinning centers; (5) both λ and ξ increased as oxygen was removed, while (6) their ratio κ and the superconductive anisotropy parameter $\gamma = (\lambda_c/\lambda_{ab}) \approx 5$ varied little for $\delta \leq 0.2$.

3615 (CONF-920944–4) **Magnetic studies of current conduction and flux pinning in high-T_c cuprates: Virgin, irradiated, and oxygen deficient materials.** Thompson, J.R. (Oak Ridge National Lab., TN (United States)); Sun, Yang Ren; Ossandon, J.G.; Christen, D.K.; Kerchner, H.R.; Sales, B.C.; Chakoumakos, B.C.; Civale, L.; Marwick, A.D.; Holtzberg, F. Oak Ridge National Lab., TN (United States). Sep 1992. 11p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. From 6. annual New York State Institute on Superconductivity (NYSIS) conference on superconductivity and applications; Buffalo, NY (United States); 15-17 Sep 1992. Order Number DE93001716. Source: OSTI; NTIS; INIS; GPO Dep.

To increase the current density and pinning of magnetic flux in high temperature superconductors, defects with point-like and line-like geometries were created in controlled numbers using ion irradiation methods. Single crystals of $Y_1Ba_2Cu_3O_7$ and $Bi_2Sr_2Ca_1Cu_2O_8$ superconductors were studied using dc magnetic methods. These studies showed greatly increased irreversibility in the vortex state magnetization and enhanced intragrain current density J_c following irradiation. Linear defects, created by irradiation with energetic heavy ions, are particularly effective in pinning vortices at higher temperatures and magnetic fields. Further investigations of "flux creep" (the time dependence of magnetization) are

well described by recent vortex glass and collective pinning theories. Complementary investigations have delineated the role of oxygen deficiency δ on pinning in aligned $Y_1Ba_2Cu_3O_{7-\delta}$materials.

3616 (CONF-9210182–1) **The design and properties of ceramics reinforced by whiskers and similar microstructural features.** Becher, P.F.; Alexander, K.B.; Hsueh, C.H.; Lin, H.T.; Tiegs, T.N.; Warwick, W.H. Oak Ridge National Lab., TN (United States). [1992]. 30p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. From Advanced workshop on whiskers and particles in composite materials technology; Trieste (Italy); 5-9 Oct 1992. Order Number DE93001372. Source: OSTI; NTIS; GPO Dep.

Whiskers impart considerable toughening and provide increased resistance to strength degradation during service due to thermal stresses, crack growth, and contact or impact damage. Whisker-reinforced ceramics also exhibit improvements in strength and toughness that are retained over a broad temperature range. Furthermore, reinforcements that resist deformation at elevated temperatures, e.g., SiC whiskers, result in substantial improvements in creep resistance of ceramics. However, successful design of toughened ceramics must consider the material properties and characteristics which control the toughening response and related mechanical properties. This paper reviews the design concepts for ceramics reinforced with discontinuous phases and the influence of such reinforcements on a variety of mechanical properties. 39 refs, 13 figs.

3617 (DOE/ER/13732–6) **Molecular and polymeric ceramic precursors: Research progress report.** Sneddon, L.G. Pennsylvania Univ., Philadelphia, PA (United States). Dept. of Chemistry. Jun 1992. 8p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG02-87ER13732. Order Number DE93002841. Source: OSTI; NTIS; GPO Dep.

The development of new methods for the production of complex materials is one of the most important problems in modern solid state chemistry and materials science. This project is attempting to apply the synthetic principles which have evolved in inorganic and organometallic chemistry to the production of technologically important non-oxide ceramics, such as boron nitride, boron carbide and metal borides. Recent work has now resulted in the production of new polymer systems, including poly(B-vinylborazine), polyvinylpentaborane and polyborazylene, that have proven to be high yield precursors to boron-based ceramic materials. Current work is now directed toward the synthesis of new types of molecular and polymeric boron-containing species and an exploration of the solid state properties of the ceramics that have been produced in these studies.

3618 (DOE/ER/14017–4) **Flux flow, pinning, and resistive behavior in superconducting networks: Annual progress report, May 1, 1992–April 30, 1993.** Teitel, S. Rochester Univ., NY (United States). Dept. of Physics and Astronomy. Oct 1992. 10p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG02-89ER14017. Order Number DE93002707. Source: OSTI; NTIS; INIS; GPO Dep.

We have studied the behavior of fluctuation effects in superconducting systems using numerical simulations of XY and Coulomb gas models. The fluctuation of vortex lines in high temperature superconductors, in the presence of an external magnetic field, has been studied using a three dimensional XY model. We have carried out new simulations on a more dilute vortex line model than we considered previously, and find surprising evidence that the process of vortex line lattice melting occurs as two distinct phase transitions. As the vortex line lattice is heated, it melts first into a vortex line liquid of straight unentangled lines, having superconducting properties in the direction along the lines (parallel to the external field), but not in directions transverse to the lines. At a higher temperature, the thermal excitation of closed vortex line loops links all the lines together, leading to a tangled vortex line liquid, with completely normal metal properties in all directions. We have also continued simulations of the two dimensional Coulomb gas, as a model for vortex fluctuations in two dimensional arrays of Josephson junctions. We find phase transitions which do not have the critical behavior expected from standard symmetry analyses.

3619 (DOE/ER/45097–9) **Defect clustering in simple and complex oxides: Progress report, June 1, 1992–May 31, 1993.** Cohen, J.B.; Ellis, D.E.; Mason, T.O. Northwestern Univ., Evanston, IL (United States). Oct 1992. 7p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG02-84ER45097. Order Number DE93002652. Source: OSTI; NTIS; GPO Dep.

Vacancy:interstitial clusters in $Fe_{1-x}O$ were surveyed theoretically, and the 7:2 cluster is predicted to be the most stable, followed by 4:1. In $Mn_{1-x}O$, the 2:1 cluster is predicted to be the most stable, followed by 6:2. The $Co_{1-x}O$ is still unresolved, although the 2:1 cluster should be the most stable. Work on complex oxides is also reported, including REAECuO (RE=rare earth, AE=alkaline earth), NdCeCuO, LaCuO-based cuprates, and doped sapphire.

3620 (DOE/ER/45113–T4) **Superconducting materials performance report, May 1, 1992–February 28, 1993.** Ruvalds, J. Virginia Univ., Charlottesville, VA (United States). Dept. of Physics. [1992]. 15p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG05-84ER45113. Order Number DE93002786. Source: OSTI; NTIS; GPO Dep.

An unusual frequency and temperature variation of the spin susceptibility for electrons or holes whose Fermi surfaces exhibit nesting. This explains the electronic transport properties of high temperature superconductors (HTS), including optical reflectivity and Raman spectra. Direct evidence for predicted scaling of susceptibility as a function of frequency/T was detected by neutron scattering on two series of cuprate superconductors. Calculations were extended to electronic structure models for generating lineshapes that may be tested. Good agreement with T and frequency variation of susceptibility measured by neutrons is achieved in the nesting regime. These findings are relevant to anomalous linear temperature variation of electrical resistivity characteristic of HTS. Electron-electron scattering processes become dominant in nested surfaces if the Coulomb interaction between charges is of intermediate strength.

3621 (DOE/ER/45279–1) **Ceramic decomposition under irradiation, 1987: Progress report.** Howitt, D.G. California Univ., Davis, CA (United States). Dept. of Mechanical Engineering. 1987. 8p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG03-86ER45279. Order Number DE93002679. Source: OSTI; NTIS; GPO Dep.

Our quantitative determinations of the decomposition of thin film and bulk ceramic materials during electron microscopy has shown that the radiation damage effect is a complex one depending dielectric and thermochemical properties. In low melting temperature glasses, for example, much of the activity is due to field enhanced diffusion of low atomic weight species. This is particularly true of bulk specimens and for the case of binary soda-borosilicate glass the sodium depletion in the SEM can be quantitatively described in terms of this effect. Studies with thin specimens of refractory carbides show that in these materials the carbon depletion is due to direct displacement processes and that here the electric fields give rise to recombination effects. The studies of ceramic thin films suitable for reference standards is continuing as a joint effort with the Rockwell Science Center. Work is in progress to describe the in plane crystallization that is observed in terms of the latent heat involved and the configurational entropy of the propagating interface.

3622 (DOE/ER/45283–11) **X-ray studies of microstructures in semiconductors and superconducting materials.** Kao, Y.H. State Univ. of New York, Buffalo, NY (United States). Dept. of Physics and Astronomy. Apr 1992. 17p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG02-87ER45283. Order Number DE93001953. Source: OSTI; NTIS; GPO Dep.

Objective is to use synchrotron x rays to probe short-range-order (SRO) structures in these materials. These SRO structures, with a scale of a few angstroms, include these around interfaces in multilayers, strain and local environs around impurity or constituent atoms, as well as lattice mismatch, intermixing of atoms across interfaces, annealing, etc. A new soft x-ray detector has been built and was used to measure x-ray fluorescence from O and F in bulk materials. The research on microstructure in both semiconductors and high-T_c superconductors is being continued with emphasis on multilayer materials. X-ray absorption fine structure spectroscopy is being used in many of the studies, as is grazing incidence x-ray

fluorescence and scattering. Total electron yield is used with fluorescence to probe surfaces and interfaces. Effects of doping on superconducting properties, especially these related to microstructures around impurities or constituent atoms, were studied. Resulting papers are listed.

3623 (DOE/ER/45337–5) **Fundamental studies of stress distributions and stress relaxation in oxide scales on high temperature alloys: Progress report.** Shores, D.A.; Stout, J.H.; Gerberich, W.W. Minnesota Univ., Minneapolis, MN (United States). Corrosion Research Center. Jun 1992. 28p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG02-88ER45337. Order Number DE93003654. Source: OSTI; NTIS; GPO Dep.

The high temperature X-ray diffraction system developed for this program is being used to measure the strains which develop during oxidation. This is being applied to Ni/NiO and Cr/Cr_2O_3. Our work suggests tat the oxide and metal crystalline texture, anisotropic elastic modulus and anisotropic thermal expansion can have a pronounced effect on strain state of these systems. Acoustic emission is being used to study oxide scale failure (fracture) during oxidation. AE data from 304 stainless steel are being used to develop a statistical model of fracture process. Strength of metal/scale interface is an important property that has been difficult to quantify. Using Nano-indentation and scratch techniques developed for characterizing thin film interfaces, an effort has begun to measure the fracture toughness of the metal/scale interface. Mathematical modelling of origin and time evolution of growth stresses is an extension and improvement of previous models. The current effort employs a more sophisticated stress analysis and expands the scope to include other stress relaxation process. The interaction between the modeling studies and the X-ray diffraction measurements provides a natural credibility check to both efforts.

3624 (DOE/ER/54115–T2) **Radiation effects and micromechanics of SiC/SiC composites: Annual technical report, November 15, 1991–November 14, 1992.** Ghoniem, N.M. California Univ., Los Angeles, CA (United States). Dept. of Mechanical, Aerospace and Nuclear Engineering. [1992]. 5p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG03-91ER54115. Order Number DE93003268. Source: OSTI; NTIS; INIS; GPO Dep.

The basic displacement damage process in SiC has been fully explored, and the mechanisms identified. Major modifications have been made to the theory of damage dosimetry in Fusion, Fission and Ion Simulation studies of Sic. For the first time, calculations of displacements per atoms in SiC can be made in any irradiation environment. Applications to irradiations in fusion first wall neutron spectra (ARIES and PROMETHEUS) as well as in fission spectra (HIFIR and FFTF) are given. Nucleation of helium-filled cavities in SiC was studied, using concepts of stability theory to determine the size of the critical nucleus under continuous generation of helium and displacement damage. It is predicted that a bimodal distribution of cavity sizes is likely to occur in heavily irradiated SiC. A study of the chemical compatibility of SiC composite structures with fusion reactor coolants at high-temperatures was undertaken. It was shown that SiC itself is chemically very stable in helium coolants in the temperature range 500–1000°C. However, current fiber/matrix interfaces, such as C and BN are not. The fracture mechanics of high-temperature matrix cracks with bridging fibers is now in progress. A fundamentally unique approach to study the propagation and interaction of cracks in a composite was initiated. The main focus of our research during the following period will be : (1) Theory and experiments for the micro-mechanics of high-temperature failure; and (2) Analysis of radiation damage and microstructure evolution.

3625 (EGG-M–92280) **Single parameter analysis of hysteretic magnetic flux trapping in high T_c superconductor ribbon.** Telschow, K.L. EG and G Idaho, Inc., Idaho Falls, ID (United States). [1992]. 6p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC07-76ID01570. (CONF-920799–2: Review of progress in quantitative non destructive evaluation (NDE), La Jolla, CA (United States), 19-24 Jul 1992). Order Number DE93001924. Source: OSTI; NTIS; INIS; GPO Dep.

This paper described the application of an AC surface probe, similar to presently used eddy current probes, to the measurement of DC transport critical currents and critical state dissipation in high $T_c$superconductors. It has been shown that the probe can provide quantitative measurement of the full field penetration in superconducting samples by measuring the response of AC induced screening currents for superconducting materials in the form of tapes with overlayers of silver. In this manner, the AC probe can be used to replace the contact DC probe for determining critical currents in a noncontacting and local manner suitable for scanning over or along the sample.

3626 (INIS-BR–2987) **Superconducting films of YBaCuO.** Coelho, A.L. Instituto de Pesquisas Energeticas e Nucleares (IPEN), Sao Paulo, SP (Brazil). 1991 59p. (In Portuguese). Order Number DE93606831. Source: OSTI; NTIS (US Sales Only); INIS.

Thick films of $YBa_2 Cu_3 O_{7-x}$ have been prepared on alumina and YSZ (Yttria-stabilized zirconia) substrates by the screen printing technique. Several experimental conditions have been studied, for instance: sintering time, temperature, thickness and atmosphere annealed. The resulting films have been characterized by X-ray diffraction, AC electrical resistance, AC susceptibility and scanning electron microscopy. The surface and cross-section have been observed with an optical microscope. The X-ray diffraction patterns have been compared with a typical pattern and that has indicated the good quality of the samples. AC resistance and its temperature dependence have been measured in the standard four-probe configuration. Films thickness has been estimated in the scanning electron microscope. This technique has been suitable for production of high T_c superconducting films being a simple and inexpensive method. (author).

3627 (INIS-BR–2988) **Effect of lead addition on the formation of superconducting phases in Bi-Sr-Ca-Cu-O ceramics.** Martinelli, A.E. Instituto de Pesquisas Energeticas e Nucleares (IPEN), Sao Paulo, SP (Brazil). 1991 82p. (In Portuguese). Order Number DE93606893. Source: OSTI; NTIS (US Sales Only); INIS.

Superconducting ceramics with starting composition $Bi_{2-x} Pb_x Sr_2 Ca_2 Cu_3 O_y$ ($0,0 \leq X \leq 0,6$) were prepared in order to investigate the effects of partial substitution of Pb for Bi and sintering time and atmosphere in the formation of superconducting phases. For all samples X-ray diffraction analyses were performed to estimate the amount of superconducting phases; superconductivity was analysed by dc electrical resistance and ac magnetic susceptibility measurements. The main results show that: (a) the longer the sintering time (up to 168 h), the larger the volume fraction of superconducting phases with critical temperature (T_c) greater than the temperature of nitrogen liquefaction; (b) by partially substituting Pb for Bi it is possible to restrain the formation of 2212 phase (T_c = 80 K) and to enhance the amount of 2223 phase (T_c = 105 K); (c) a heat treatment under oxygen atmosphere before sintering enhances the formation of 2223 phase. (author).

3628 (INIS-BR–2989) **The effect of $Bi_2 O_3$ on the electrical properties of Zr O_2: 3 wt% Mg O ceramic solid electrolytes.** Cosentino, I.C. Instituto de Pesquisas Energeticas e Nucleares (IPEN), Sao Paulo, SP (Brazil). 1991 64p. (In Portuguese). Order Number DE93607029. Source: OSTI; NTIS (US Sales Only); INIS.

Zr O_2: 3 wt% Mg O ceramic solid electrolytes have been prepared to study the effect of $Bi_2 O_3$ addition on densification and electrical conductivity. Microstructural characterization have been done by X-ray diffractometry, scanning electron microscopy and electron microprobe analyses. Electrical conductivity measurements have been done by two probe dc technique in the 400^0 C - 700^0 C temperature range. The results show that 5 wt% $Bi_2 O_3$ addition improves densification: 93% TD and 98% TD specimens are obtained from zirconia stabilized by powder mixture and by coprecipitation of oxides, respectively. Moreover, electrical conductivity values are found to be two orders of magnitude higher for Zr O_2 : 3 wt% Mg O with 5% $Bi_2 O_3$. (author).

3629 (INIS-mf–13378) **Vanadium extraction by combined process of lixiviation and toasting.** Coral, Aldo (Universidad Central del Ecuador, Facultad de Ingenieria, Ciencias Fisicas y Matematicas, Escuela de Ingenieria Quimica Quito (Ecuador)). Universidad Central del Ecuador, Quito (Ecuador). 1992 184p. (In Spanish). Order Number DE93606832. Source: OSTI; NTIS (US Sales Only); INIS.

Combinated toasting and leaching processes were applied at laboratory level to vanadiferous ore from Puyango deposit in order to evaluate different rates. Before leaching, a pretreatment consisting in toasting at open atmosphere was given to the ore. Both raw and toasted ore were later washed in organic solvents. In reason of mineralogical and petrographic characteristics of the ore, only alcaline leaching was tested under different pressure temperature and pH conditions of leaching solution (pH=9.8) in order to optimize time and efficiency of each individual process. Four different unitary alcaline leaching processes were studied: MECHANICAL STIRRING, PNEUMATIC STIRRING, LEACHING IN AUTOCLAVE AND LEACHING IN COLUMNS. For these four processes were obtained recovery rates (in percentage) of 18.63 and 87.82; 17.03 and 82.57; 60.42 and 99.55; 2.5 and 30.10; respectively from raw and pre-toasted ore. After filtration, vanadium was extracted from enriched solutions by using liquid resin ALAMINE 336, selective for vanadium at pH=2.8. Vanadium was later discharged with a Sodium Carbonate solution (10 per cent) and finally precipitated as the commercial compound Ammonium Vanadate, NH4VO3. Nuclear techniques as X-ray fluorescence and Atomic Absorption spectroscopy were used for analysis all over the investigation.

3630 (INPE–5372) **Tetragonal zirconia ceramics in Zr O_2-Ce O_2 system (Ce-TZP): preparation, characterization and mechanical properties.** Andrade Nono, M.C. de. Instituto de Pesquisas Espaciais (INPE), Sao Jose dos Campos, SP (Brazil). [1992]. 11p. (In Portuguese). (CONF-9206287–: 36. Brazilian congress on ceramic, Caxambu (Brazil), 7 Jun 1992; PRE–1746.). Order Number DE93606833. Source: OSTI; NTIS (US Sales Only); INIS.

This paper describes and discusses the results achieved in a study about Ce-TZP ceramics prepared from conventional powder mixtures of Zr O_2 and Ce O_2 (with composition in the range of 8 to 16 mol% Ce O_2). Physical and chemical characteristics were related with the powder compaction behavior and with the sintering state. The sintered ceramics showed a level of high porosity ($\simeq$ 4%), mainly due to the fairly adequate powder characteristics and compaction. The crystalline phases were analysed from X-rays diffraction data and showed that these ceramics can present tetragonal-to-monoclinic stress induced transformation. The bending strength, fracture toughness and Vickers hardness results were influenced by Ce O_2 content microstructure and sintering temperature. These Ce-TZP ceramics showed mechanical strength results comparable to those published in the international literature. (author).

3631 (Juel–2628) **Trace analysis of ceramics by laser ionization mass spectrometry.** Becker, J.S.; Dietze, H.J. Forschungszentrum Juelich GmbH (Germany). Zentralabteilung fuer Chemische Analysen. May 1992. 40p. Order Number DE93729053. Source: OSTI; NTIS (US Sales Only); INIS.

Among the different spectrometric techniques for trace analysis Laser Ionization Mass Spectrometry (LIMS) is well suitable as an analytical method for the determination of trace impurities in ceramics. With the LIMS technique the ceramic sample material is evaporated and ionized by means of a focused pulsed laser beam in a laser microplasma, which is formed in the spot area of the irradiated sample. All chemical elements in the sample materials are evaporated and ionized in the laser plasma. The ions formed are separated according to mass and energy by a double-focusing mass spectrometer. In this paper the characteristics, analytical features and application of laser ionization mass spectrometry in trace analysis of ceramics are described. (orig.).

3632 (KFK–4984) **Quality criteria for high T_c superconductors and on the clarification of the superconducting mechanism.** Haase, E.L.; Ruzicka, J. Kernforschungszentrum Karlsruhe GmbH (Germany). Inst. fuer Materialforschung. Mar 1992. 20p. Order Number DE93742164. Source: OSTI; NTIS (US Sales Only); INIS.

After the successful basic solution of the Nb_3Ge and Nb_3Si problems, optimization strategies and quality criteria were developed for high Tc superconducting (HTCS) samples in analogy. After improvements of the sputtering system, the preparation parameters were tightly controlled, leading to samples with a reproducible linear slope of the specific resistance ρ(T). Further improvements by us and Poppe et al. lead to the preparation of 123 films with nonlinear ρ(T) curves above 120K. A generalization to a T^2 behavior of ρ(T) leads to the further generalization that defect free HTCS are essentially two dimensional in nature, with all ensuing consequences. The momentum transport of the moving charge cariers requires, because of momentum conservation, a mechanism to transfer momentum to the lattice (momentum relaxation). The qualitative theory developed for two dimensional (2D) systems shows that the electron-phonon interaction is strongly suppressed and hence that the weaker electron-electron interaction dominates. That theory makes numerous predictions, which so far are confirmed by experiments. In particular, it accounts for the extreme temperature dependence of the mean free path and the Hall effect. It is inferred that the mechanism of HTCS is predominantly due to electron-electron interaction - probably of bipolaron nature, as indicated by experiment. At this point experiment meets just a few theories, that conform with the experimental facts and above theory, all based on the quasi-particle theory of electron-electron interaction. The theory of Newns, Pattnaik and Tsuei should have a T^2 shape of ρ(T) and, because E_F lies near a nearly logarithmic van Hove singularity, accounts for the high Tc. Ruvalds and Virosztek's theory predicts the T^2 shape of ρ(T). (orig./GSCH).

3633 (KFK–5022) **On the influence of internal interfaces and properties of multiphase hard material coatings.** Hilz, G. Kernforschungszentrum Karlsruhe GmbH (Germany). Inst. fuer Materialforschung; Karlsruhe Univ. (T.H.) (Germany). Fakultaet fuer Maschinenbau. Apr 1992. 206p. (In German). Order Number DE93742160. Source: OSTI; NTIS (US Sales Only); INIS.

In the system TiC-TiB_2-B_4C-SiC coatings with different amounts of phase boundaries were prepared by magnetron sputtering: multilayer coatings with 10, 100 and 1000 individual layers and a total thickness of 5 μm as well as single layer multiphase coatings deposited from multiphase targets on heated and unheated substrates. To know the influence of internal interfaces in those coatings, structure and properties of the corresponding single phase coatings were studied also. TEM examinations of cross-section samples showed that B_4C and SiC coatings are amorphous whereas TiC and TiB_2 coatings are crystalline with a texture which depends on deposition parameters and is developed with growing thickness of the coating. Therefore the texture of TiC and TiB_2 layers in multilayer coatings depends on the thickness of the individual layer. While the texture of single layers in multilayer SiC-TiC, SiC-TiB_2, B_4C-TiB_2, and B_4C-SiC coatings corresponds to the structure of single phase coatings of the same thickness, in TiC-TiB_2 coatings the texture of the individual layers is also influenced by the texture of the previous layer. The occurence of mixing zones between the layers depends on the materials, but also on the crystallinity of the previous layer. (orig.(MM)).

3634 (LA-UR–92-3054) **Microstructural and electronic properties of highly oriented $Tl_{0.5}Pb_{0.5}Sr_2CaCu_2O_7$ films on $LaAlO_3$.** Kountz, D.J. (Du Pont de Nemours (E.I.) and Co., Wilmington, DE (United States). Central Research and Development Dept.); Gai, P.L.; Wilker, C.; Holstein, W.L.; Pellicone, F.M.; Brainard, R.J. Los Alamos National Lab., NM (United States). [1992]. 5p. Sponsored by Department of Commerce, Washington, DC (United States). DOE Contract W-7405-ENG-36. (CONF-920802–16: Applied superconductivity conference, Chicago, IL (United States), 23-28 Aug 1992). Order Number DE93000655. Source: OSTI; NTIS; INIS; GPO Dep.

Epitaxial $Tl_{0.5}Pb_{0.5}Sr_2CaCu_2O_7$ films produced by rf magnetron sputtering followed by annealing in the presence of thallium oxide vapor have been produced on (100) $LaAlO_3$ substrates. These films are highly c-axis oriented with rocking curve full width at half maximum less than 0.4°. The resulting two copper oxide layer films exhibit microwave surface resistance at 10 GHz of 60 $\pm$ 3 $\mu\Omega$ at 4.2 K and 498 $\pm$ 10 $\mu\Omega$ at 70 K (T_c=88 $\pm$ 2 K). The degree of lattice mismatch between this phase and the $LaAlO_3$ substrate is very small resulting in epitaxial thin films. This material exhibits very little intrinsic defect structure.

3635 (ORNL/M–2309) **Materials Development Program, Ceramic Technology Project addendum to program plan: Cost effective ceramics for heat engines.** Oak Ridge National Lab.,

TN (United States). Aug 1992. 25p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. Order Number DE93003663. Source: OSTI; NTIS; GPO Dep.

This is a new thrust in the Ceramic Technology project. This effort represents an expansion of the program and an extension through FY 1997. Moderate temperature applications in conventional automobile and truck engines will be included along with high-temp. gas turbine and low heat rejection diesel engines. The reliability goals are expected to be met on schedule by end of FY 1993. Ceramic turbine rotors have been run (in DOE's ATTAP program) for 1000 h at 1370C and full speed. However, the cost of ceramic components is a deterrrent to near-term commercialization. A systematic approach to reducing this cost includes the following elements: economic cost modeling, ceramic machining, powder synthesis, alternative forming and densification processes, yield improvement, system design studies, standards development, and testing and data base development. A draft funding plan is outlined. 6 figs, 1 tab.

3636 (ORNL/TM–12133) **Ceramic Technology Project semiannual progress report for October 1991–March 1992.** Oak Ridge National Lab., TN (United States). Sep 1992. 513p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. Order Number DE93003684. Source: OSTI; NTIS; GPO Dep.

Objective is to develop the industrial technology base required for reliable ceramics for application in advanced automotive heat engines. Focus is on structural ceramics for advanced gas turbine and diesel engines, ceramic bearings and attachments, and ceramic coatings for thermal barrier and wear applications in these engines. The work is organized into the following elements: materials and processing (monolithics [SiC, SiN], ceramic composites, thermal and wear coatings, joining), materials design methodology, data base and life prediction (structural qualification, time-dependent behavior, environmental effects, fracture mechanics, NDE), and technology transfer. Individual abstracts were prepared for the individual contributions.

3637 **Superconducting wire.** Day, D.E.; Petrovic, J.J.; Gac, F.D.; Ray, C.S. To Dept. of Energy. 5 Mar 1991. USAA patent application 7-664,72. 15p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. Order Number DE93002013. Source: OSTI; NTIS; GPO Dep.

This invention consists of a method of producing superconducting wire by drawing a glass fiber with a melted powder of a superconducting wire inside the glass tube. After drawing, the glass fiber is heated to crystallize the superconducting compound. The diameter of the superconducting wires is controlled by the rate at which the glass fiber s are drawn from the glass tube.

3638 **Process for strengthening silicon based ceramics.** Kim, Hyoun-Ee; Moorhead, A.J. To Dept. of Energy. 7 Mar 1991. USAA patent application 7-665,85. 16p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. Order Number DE93002020. Source: OSTI; NTIS; GPO Dep.

A process for strengthening silicon based ceramic monolithic materials and composite materials that contain silicon based ceramic reinforcing phases that requires that the ceramic be exposed to a wet hydrogen atmosphere at about 1400°C. The process results in a dense, tightly adherent silicon containing oxide layer that heals, blunts, or otherwise negates the detrimental effect of strength limiting flaws on the surface of the ceramic body.

3639 **Apparatus and method for critical current measurements.** Martin, J.A.; Dye, R.C. To Dept. of Energy. 15 Mar 1991. USAA patent application 7-670,11. 23p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. Order Number DE93002025. Source: OSTI; NTIS; GPO Dep.

An apparatus for the measurement of the critical current of a superconductive sample, e.g., a clad superconductive sample, the apparatus including a conductive coil, a means for maintaining the coil in proximity to a superconductive sample, an electrical connection means for passing a low amplitude alternating current through the coil, a cooling means for maintaining the superconductive sample at a preselected temperature, a means for passing a current through the superconductive sample, and, a means for monitoring reactance of the coil. The alternating current capable of generating a magnetic field sufficient to penetrate, e.g., any cladding, and to induce eddy currents in the superconductive material, passing a steadily increasing current through the superconductive material, the current characterized as having a different frequency than the alternating current, and, monitoring the reactance of the coil with a phase sensitive detector as the current passed through the superconductive material is steadily increased whereby critical current of the superconductive material can be observed as the point whereat a component of impedance deviates.

3640 (PNL-SA–20885) **Ion-beam modification of $Gd_2Ti_2O_7$.** Weber, W.J.; Hess, N.J. Pacific Northwest Lab., Richland, WA (United States). Sep 1992. 16p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. (CONF-9209200–6: 8. international conference on ion beam modification of materials, Heidelberg (Germany), 7-11 Sep 1992). Order Number DE93001514. Source: OSTI; NTIS; INIS; GPO Dep.

Irradiation of $Gd_2Ti_2O_7$ with 3 MeV Ar^+ ions results in expansion of the unit-cell volume from defect accumulation as well as irradiation-induced amorphization. The damage cross-section for amorphization determined from X-ray diffraction analysis is 0.023 nm^2. Transmission electron microscopy and electron diffraction have confirmed the irradiation-induced amorphous character at high fluences. Raman spectroscopy indicates a decrease in scattered intensity and an increase in linewidth with fluence for the principal vibrational modes, consistent with increasing irradiation-induced disorder. The wavenumber of the most intense Raman peak at $\sim$ 310 cm^{-1} (attributed to the O-Gd-O bending mode) decreases with fluence, indicating a change in bond Angle. The increase in the wavenumber of the Raman peak at $\sim$ 515 cm^{-1} (attributed to the Gd-O stretching mode) with fluence suggests a decrease in bone length. At intermediate fluences, a forbidden peak at 765 cm^{-1}1 becomes slightly activated by irradiation-induced disorder on the cation sites.

3641 (SAND–91-2901C) **Electrooptic properties of PZT thin films for image storage applications.** Dimos, D.; Schwartz, R.W. Sandia National Labs., Albuquerque, NM (United States). [1992]. 7p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-76DP00789. (CONF-921206–2: Material Research Society (MRS) symposium, Boston, MA (United States), 2-6 Dec 1992). Order Number DE92008523. Source: OSTI; NTIS; GPO Dep.

The photocurrent response, photo-induced changes in hysteresis behavior, and electrooptic (birefringence) effects of sol-gel derived PZT film have been characterized as part of an effort to evaluate ferroelectric films for image storage and processing applications.

3606 Other Materials

Refer also to citation(s) 2752, 2918, 2919, 2920, 2922, 2967, 3450, 3452, 3453, 3616, 3622, 3624, 3636, 3637, 3668, 3670, 3772, 3778, 3825, 3913, 3946, 3965, 4046, 4050, 4466, 4609, 4675, 4689, 4756, 4789

3642 (BNL–47544) **Interfacial reaction in a-Si/Au and a-Si/Cu thin film bilayers.** Heald, S.M.; Tan, Z. Brookhaven National Lab., Upton, NY (United States). [1992]. 5p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC02-76CH00016 ;AS05-80ER10742. (CONF-9208160–4: 7. international conference on x-ray absorption fine structure, Kobe (Japan), 23-29 Aug 1992). Order Number DE93002324. Source: OSTI; NTIS; GPO Dep.

We have studied the interdiffusion and compound formation at the a-Si/Au and a-Si/Cu Chin film interfaces using x-ray reflectivity and grazing incidence EXAFS techniques. In the 0C as-deposited samples, reaction between Si and Au is minimal, but reaction between Si and Cu is significant. Upon annealing for ten minutes in argon, the a-Si crystallized and reacted quite extensively with Au at 160C. Further reaction between Si and Cu proceeded at 130C. The compounds formed appear to be metal-rich silicides in both the Si/Au and Si/Cu systems. For Au/Si the silicide is likely stabilized on the surface of the newly formed crystallites.

3643 (CONF-920995–1) **Short range order in amorphous polycondensates.** Lamers, C. (Forschungszentrum Juelich GmbH

(Germany). Inst. fuer Festkoerperforschung); Richter, D.; Schweika, W.; Batoulis, J.; Sommer, K.; Cable, J.W.; Shapiro, S.M. Oak Ridge National Lab., TN (United States). [1992]. 6p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400 ;AC02-76CH00016. From Determination of partial structure factors of disordered matter by neutron and anomalous x-ray diffraction; Grenoble (France); 10-11 Sep 1992. Order Number DE93001650. Source: OSTI; NTIS; GPO Dep.

The static coherent structure factors S(Q) of the polymer glass Bisphenol-A-Polycarbonate and its chemical variation Bisphenol-A-Polyctherkctone- both in differently deuterated versions- have been measured by spin polarized neutron scattering. The method of spin polarization analysis provided an experimental separation of coherent and incoherent scattering and a reliable intensity calibration. Results are compared to structure factors calculated for model structures which were obtained by "amorphous cell" computer simulations. In general reasonable agreement is found between experiment and simulation; however, certain discrepancies hint at an insufficient structural relaxation in the amorphous cell method. 15 refs, 1 fig, 1 tab.

3644 (CONF-9209245–1) **Ion beam application for improved polymer surface properties.** Lee, E.H.; Rao, G.R.; Lewis, M.B.; Mansur, L.K. Oak Ridge National Lab., TN (United States). [1992]. 13p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. From 9. international conference on ion implantation technology; Gainesville, FL (United States); 21-24 Sep 1992. Order Number DE93001375. Source: OSTI; NTIS; INIS; GPO Dep.

Various polymeric materials were subjected to bombardment by different energetic ions with energies ranging from 200 to 1000 keV. Tests showed substantial improvements in hardness, wear resistance, oxidation resistance, resistance to chemicals, and electrical conductivity. The magnitude of property changes was strongly dependent upon ion species, energy, dose, and polymer structure. Both hardness and electrical conductivity increased with ion energy and dose. These properties were apparently related to the effectiveness of cross-linking. Ion species with a large electronic stopping cross-section are expected to produce more crosslinking. It is believed that the polymer property improvements are commensurate with the extent of crosslinking, which is responsible for the formation of three-dimensionally-connected, carbon-rich, rigid networks. 22 refs, 5 figs.

3645 (DOE/CE/15974–T1) **Progress report on conductive paints, August 3, 1992–September 30, 1992.** Soukup, R.J.; Ianno, N.J. Nebraska Univ., Lincoln, NE (United States). Dept. of Electrical Engineering. [1992]. 7p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG01-92CE15974. Order Number DE93001353. Source: OSTI; NTIS; GPO Dep.

Several different paint deposition methods (spraying, rolling, spinning) were explored. Adhesion strength and electric resistivity were measured.

3646 (DOE/ER/45204–T5) **Multifunctional nanocomposite materials: Progress report.** Roy, R.; Komarneni, S. Pennsylvania State Univ., University Park, PA (United States). Materials Research Lab. Nov 1991. 9p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG02-85ER45204. Order Number DE93002767. Source: OSTI; NTIS; GPO Dep.

Objective is to examine the low temperature nanocomposite route in the synthesis of multifunctional materials using two-dimensional clays as hosts. After about 8 months, a significant advance was made in the design and synthesis of novel nanocomposite materials, which are nanometal intercalated clays prepared by a low temperature route. A layered V_2O_5 gel has been made hydrothermally and its cation exchange properties measured. Several pillared clays have also been synthesized and characterized.

3647 (DOE/ER/45208–8) **He atom surface scattering: Surface dynamics of insulators, overlayers and crystal growth: Progress report, May 1, 1992–April 30, 1993.** Florida State Univ., Tallahassee, FL (United States). [1992]. 28p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG05-85ER45208. Order Number DE93002788. Source: OSTI; NTIS; INIS; GPO Dep.

Investigations have focused primarily on surface structure and dynamics of ionic insulators, epitaxial growth onto alkali halide crystals and multiphoton studies. The surface dynamics of RbCl has been re-examined. We have developed a simple force constant model which provides insight into the dynamics of KBr overlayers on NaCl(001), a system with a large lattice mismatch. The KBr/NaCl(001) results are compared to Na/Cu(001) and NaCl/Ge(001). We have completed epitaxial growth experiments for KBr onto RbCl(001). Slab dynamics calculations using a shell model for this system with very small lattice mismatch are being carried out in collaboration with Professor Manson of Clemson University and with Professor Schroeder in Regensburg, Germany. Extensive experiments on multiphoton scattering of helium atoms onto NaCl and, particularly, LiF have been carried out and the theory has been developed to a rather advanced stage by Professor Manson. This work will permit the extraction of more information from time-of-flight spectra. It is shown that the theoretical model provides a very good description of the multiphoton scattering from organic films. Work has started on self-assembling organic films on gold (alkyl thiols/Au(111)). We have begun to prepare and characterize the gold crystal; one of the group members has spent two weeks at the Oak Ridge National Laboratory learning the proper Au(111) preparation techniques. One of our students has carried out neutron scattering experiments on NiO, measuring both bulk phonon and magnon dispersion curves.

3648 (DOE/ER/45294–T4) **Brittle to ductile transition in cleavage fracture: Final techical report, April 1, 1987–June 30, 1991.** Argon, A.S.; Berg, Q. Massachusetts Inst. of Tech., Cambridge, MA (United States). Dept. of Mechanical Engineering. 30 Sep 1992. 8p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG02-87ER45294. Order Number DE93002466. Source: OSTI; NTIS; GPO Dep.

The problem of interpretation of fracture transition from brittle to ductile or vice versa is the subject of study. An instrumented tapered double cantilever beam (TDCB) has been developed as a definitive tool in the study of the intrinsic mechanism in single crystalline samples. In this experiment, the crack velocity is directly proportional to actuator velocity. In experiments performed on TDCB shaped Si single crystals, oriented for cleavage on either {111} or {110} planes, a number of troubling features of jerky carck extension were encountered. Evidence suggests that nucleation of dislocation loops from crack tip is easier than moving these dislocations away from crack tip. 14 refs, 1 fig.

3649 (DOE/ER/45347–51) **Optical and magnetic signatures of localized excitations in polyaniline.** Su, W.P. (Houston Univ., TX (United States). Dept. of Physics); Epstein, A.J.; Kim, J. Ohio State Univ., Columbus, OH (United States). [1992]. 6p. Sponsored by USDOE, Washington, DC (United States); Department of Defense, Washington, DC (United States). DOE Contract FG02-88ER45347. Order Number DE93001954. Source: OSTI; NTIS; INIS; GPO Dep.

Using a tight-binding Hamiltonian we study the lattice configurations and electronic structures of three forms of polyaniline: leucoemeraldine base (LEB), emeraldine base (EB) and pernigraniline base (PNB). Both bond length and ring rotation angle are considered in the structure relaxation. The dominant elementary excitations of isolated chains are found to be solitons is PNB and bipolarons in EB and in LEB. Optical absorptions of the ground states and of the solitonic and polaronic excitations are calculated and compared with experiments. The spin density profile of a single neutral soliton in PNB is discussed in connection with magnetic measurements.

3650 (DOE-HMIP-RR–92-026) **The effects of radiation (beta/gamma and alpha) on cemented intermediate level waste.** Jones, D.V.C. (AEA Industrial Technology, Harwell (United Kingdom)); Wilding, C.R. Department of the Environment, London (United Kingdom). Her Majesty's Inspectorate of Pollution. Feb 1990. 44p. (PECD–7-9-561;AEA-InTec–0442.). Order Number DE93607091. Source: OSTI; NTIS (US Sales Only); INIS.

A worldwide review of what has been published on the effects of radiation on cemented ILW has been carried out where properties such as composition and volume of any gas evolved/absorbed,

physical properties, chemical evolution and dose rate were considered. It is clear that only a superficial knowledge of the underlying reasons for radiolytic effects exist although there is sufficient data to enable quantities of gas a function of storage time to be predicted. If long term predictions of behaviour are to be made then the understanding of basic radiation chemistry of cement grout needs to be developed in parallel with the wider study of understanding the effects at the elevated temperatures expected to be present in a repository. (author).

3651 (DOE-HMIP-RR-92-027) **The effects of radiation on intermediate-level wasteforms: final report.** Wilding, C.R. (AEA Industrial Technology, Harwell (United Kingdom)); Phillips, D.C.; Lyon, C.E.; Burnay, S.G.; Winter, J.A.; Spindler, W.E. Department of the Environment, London (United Kingdom). Her Majesty's Inspectorate of Pollution. Oct 1990. 30p. (PECD-7-9-356;AERE-R-13809.). Order Number DE93607092. Source: OSTI; NTIS (US Sales Only); INIS.

This report summarizes the results of a programme carried out on the evaluation of the effects of radiation on organic ion exchangers in cement, mixed ion exchangers in modified vinyl ester polymer, immobilised fuel hull residues in cement, incinerator ash in cement and combustible PCM in cement. Both β/γ and α irradiation experiments were carried out over a range of dose rates. Cracking and spallation can occur over a wide range of water/cement ratios at a high dose rate of 3.0 Gy s^{-1} for grouts based on blast furnace slag compositions. Gas pressurisation is the most likely mechanism for the damage. Cement pore water extracted from irradiated samples of combustible PCM had a pH of 9.8 after 9.0 MGy compared to 13.0 for unirradiated controls. (author).

3652 (ECN-RX-92-027) **The defect chemistry of $LaMnO_{3\pm\delta}$: Part 3: The density of $(La,A)MnO_{3+\delta}$ (A=Ca,Sr,Ba).** Van Roosmalen, J.A.M.; Cordfunke, E.H.P. Netherlands Energy Research Foundation (ECN), Petten (Netherlands). Jun 1992. 8p. Order Number DE92557264. Source: OSTI; NTIS (US Sales Only).

Submitted to Journal of Solid Chemistry.

The density of $La_{1-x}A_xMnO_{3+\delta}$ (A=Ca,Sr,Ba) was determined for x = 0, 0.15, 0.30 (A=Ca,Sr,Ba) and for x = 0.50 (A=Sr) using a pycnometer, defect chemical considerations, lattice parameters, and chemical analyses. The oxygen excess in $LaMnO_{3+\delta}$ is compensated by both La as well as Mn vacancies in equal amounts. This is confirmed by density measurements. According to this defect model the density of $LaMnO_{3+\delta}$ is almost independent of δ for $0 \leq \delta \leq 0.18$, and is calculated to be (6.57 $\pm$ 0.02) g.cm^{-3}. The same defect model is applied to calculate the density of $La_{1-x}A_xMnO_{3+\delta}$. 1 fig., 2 tabs., 15 refs.

3653 (ECN-RX-92-028) **Carrier-induced magnetic properties in small-gap semiconductors.** Eggenkamp, P.J.T. (Dept. of Physics, Eindhoven Univ. of Technology (Netherlands)); Swagten, H.J.M.; Swueste, C.H.W.; De Jonge, W.J.M.; Story, T.; Vennix, C.W.H.M. Netherlands Energy Research Foundation (ECN), Petten (Netherlands). Jun 1992. 15p. Order Number DE92557267. Source: OSTI; NTIS (US Sales Only).

Contribution to the International Conference on Narrow Gap Semiconductors, Southampton (UK), 19-23 July 1992.

In the small-gap semiconductor $Pb_{1-x-y}Sn_yMn_xTe$ the magnetic phase transition from a ferromagnetic to a spin-glass state at high carrier concentrations is studied. New data of magnetisation, ac susceptibility, and specific heat for various carrier concentrations showing the transition are presented. Also the results of frequency dependent ac susceptibility measurements are presented. For the spin-glass sample there is a strong dependence on the measuring frequency, which follows the Vogel-Fulcher law. Furthermore, the phase boundary in the x-p magnetic phase diagram, using the Mean Random Field model, is calculated. There is a satisfactory agreement between the experimental data and the calculations. 5 figs., 14 refs.

3654 (ECN-RX-92-029) **The vibrational spectra of gaseous and liquid tetraethoxysilane.** Van der Vis, M.G.M.; Konings, R.J.M.; Oskam, A.; Snoeck, T.L. Netherlands Energy Research Foundation (ECN), Petten (Netherlands). Jun 1992. 18p. Order Number DE92557263. Source: OSTI; NTIS (US Sales Only).

To be published in Journal of Molecular Structure.

Tetraethoxysilane (TEOS) is an interesting material for the Chemical Vapour Deposition (CVD) of thin silicon dioxide films. The infrared and Raman spectra of gaseous and liquid TEOS, $Si(OC_2H_5)_4$, have been recorded and a complete assignment has been made. A structure for gaseous TEOS has been proposed based upon S_4 symmetry as in tetramethoxysilane and tetramethoxymethane. Thermodynamic functions of gaseous TEOS have been calculated from the moment of inertia, derived from this structure, and the assigned vibrational frequencies. 3 figs., 7 tabs., 25 refs.

3655 (IS-M-720) **A solid state approach to the production of kilogram quantities of Si- 20 at.% Ge thermoelectric alloys.** Cook, B.A.; Harringa, J.A.; Beaudry, B.J. Ames Lab., IA (United States). [1992]. 8p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-82. (CONF-930103-5: 10. symposium on space nuclear power and propulsion, Albuquerque, NM (United States), 10-14 Jan 1993). Order Number DE92018803. Source: OSTI; NTIS; GPO Dep.

A critical engineering question in the development of improved materials for thermal-to-electrical power generation is whether the research-scale process or methodology is amenable to production of kilogram quantities. Research efforts on the solid state technique of mechanical alloying have shown that both n- and p-type Si-20 at. % Ge alloys can be produced which have improved thermoelectric properties compared to state-of-the-art MOD-RTG materials. Studies on the production of large quantities of mechanically alloyed powder alloys using a planetary mill indicate that properties similar to those observed in alloys prepared in smaller quantities by a vibratory mill can be obtained. The characterization of several p-type alloys doped with 1 at. % B in the form SiB_4 by X-ray diffraction, scanning laser mass spectrometry, Hall effect, and high temperature electrical resistivity and Seebeck coefficient studies is described. The properties of these alloys are shown to be comparable with those measured on similar samples prepared in small quantities by a vibratory mill approach.

3656 (Juel-2422) **Preparation and properties of lithium hydride.** Condon, J.B. Forschungszentrum Juelich GmbH (Germany). Inst. fuer Festkoerperforschung. Jan 1991. 51p. Order Number DE93729019. Source: OSTI; NTIS (US Sales Only); INIS.

The properties and preparation of Li hydride are presented primarily from a thermodynamic point of view. Several preparations and fabrication methods are briefly described. The crystal structure is given along with the thermal expansion and compressibility. The thermodynamics are described for three regions: the α-region which is the solubility of hydrogen in Li metal, the β region which is the description of the defect region of the Li hydride and the $(\alpha+\beta)$ or plateau region. The α region is best described by the regular solution theory of hydrogen dissolved in Li The β region is described by the assumption that both Li ion and hydrogen ion vacancies are present. This assumption is supported by the spectroscopic and diffusion data, although the possibility of hydrogen interstitials has not been eliminated. The equilibrium two phase region and the heat capacity of pure LiH(D) are well characterized both above and below the melting point of LiH(D). The possibility and evidence of a Curie point at about 12 K for pure LiH(D) is presented. (orig.).

3657 (KFK-4991) **Study of surface properties and adhesion mechanisms between layers of different composition with surface analytical methods.** Olschewski, T. Kernforschungszentrum Karlsruhe GmbH (Germany). Inst. fuer Radiochemie; Karlsruhe Univ. (T.H.) (Germany). Fakultaet fuer Chemie. Jul 1992. 127p. (In German). Order Number DE93728953. Source: OSTI; NTIS (US Sales Only).

The aim of this investigation was to record structural and surface-chemical properties affecting the adhesion of organic layers on inorganic substrates - e.g. PMMA on oxidized titanium for the LIGA-process and PVC on Si_3N_4 for chemical microsensors based on a field-effect-transistor (FET). For this purpose the materials involved were characterized using surface analytical tools like XPS, AES and SIMS. Previously the stability of the organic materials were investigated under analytical conditions and the measurement techniques were adapted accordingly. After that, the effects of pre-

and posttreatment steps which are used for the optimization of microstructure adhesion on the function of chemical microsensors were investigated on the respective substrates. (orig.).

3658 (LA-UR–92-684) **Dependence of buried $CoSi_2$ resistivity on ion implantation and annealing conditions.** Namavar, F. (Spire Corp., Bedford, MA (United States)); Kalkhoran, N.M.; Manke, J.M.; Luo, L.; McGinn, J.T. Los Alamos National Lab., NM (United States). [1992]. 9p. Sponsored by USDOE, Washington, DC (United States); National Aeronautics and Space Administration, Washington, DC (United States). DOE Contract W-7405-ENG-36. (CONF-921206–3: Material Research Society (MRS) symposium, Boston, MA (United States), 2-6 Dec 1992). Order Number DE92010080. Source: OSTI; NTIS; GPO Dep.

We have investigated the dependence of electrical and material properties of buried $CoSi_2$ layers on Co+ implantation and annealing conditions. The results indicated that the electrical resistivity and crystalline quality of the implanted buried $CoSi_2$ layers depend strongly on the implantation temperature. $CoSi_2$ layers with the lowest resistivity and best crystalline quality (χ_{min} as low as 3.6%) were obtained from samples implanted at 300°C–400°C. Implantation at higher temperatures (e.g., 580°C) produced cobalt disilicide layers with significantly higher electrical resistivity and a χ_{min} of about 10.7%.

3659 (LBL–32470) **TEM structure investigations of low-temperature MBE grown InAlAs layers on InP⟨001⟩ substrate.** Werner, P. (Lawrence Berkeley Lab., CA (United States)); Liliental-Weber, Z.; Yu, K.M.; Weber, E.R.; Rek, Z.; Metzger, R. Lawrence Berkeley Lab., CA (United States). Apr 1992. 6p. Sponsored by USDOE, Washington, DC (United States); Department of Defense, Washington, DC (United States). DOE Contract AC03-76SF00098. Contract AFOSR-ISSA-90-0009. (CONF-920402–58: 1992 Material Research Society (MRS) spring meeting, San Francisco, CA (United States), 27 Apr - 2 may 1992). Order Number DE92041199. Source: OSTI; NTIS; GPO Dep.

The real crystal structure of $In_{0.52}Al_{0.48}As$ layers grown on InP<001> substrate as a function of the growth temperature (between 150°C and 450°C) was investigated. Following structural/electrical analysis were applied to the samples: transmission electron microscopy (TEM) , x-ray diffraction and particle induced x-ray emission (PIXE). In the temperature range between 200°C and 450°C good epitaxial growth of InAlAs layers can be achieved with a low density of dislocations and stacking faults. Ordering of group-III elements on (111) planes was observed for these layers. Structure models of such ordered domains are discussed. At growth temperatures below 300°C additional As (≈2%) is incorporated in the lattice. Growth at temperatures below 200°C leads to the formation of pyramidal defects with As grains in their cores. As-grown as well as annealed InAlAs layers show a nearly constant, high electrical resistance (10^6–$10^7\Omega$cm) in the whole temperature range.

3660 **High rate chemical vapor deposition of carbon films using fluorinated gases.** Stafford, B.L.; Tracy, C.E.; Benson, D.K.; Nelson, A.J. To Dept. of Energy. 15 Mar 1991. USAA patent application 7-669,71. 27p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC02-83CH10093. Order Number DE93002028. Source: OSTI; NTIS; GPO Dep.

A high rate, low temperature deposition of amorphous carbon films is produced by PE-CVD in the presence of a fluorinated or other halide gas. The deposition can be 5 performed at less than 100C, including ambient room temperature, with a radio frequency plasma assisted chemical vapor deposition process. With less than 6.5 at% fluorine incorporated into the amorphous carbon film, the characteristics of the carbon film, including index of 10 refraction, mass density, optical clarity, and chemical resistance are within 15% of those characteristics for pure amorphous carbon films, but the deposition rates are high.

3661 (SAND–92-0175C) **Spectroscopic and microstructural characterization of solution chemistry effects in PZT thin film processing.** Schwartz, R.W.; Assink, R.A.; Headley, T.J. Sandia National Labs., Albuquerque, NM (United States). [1992]. 11p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-76DP00789. (CONF-921206–1: Material Research Society (MRS) symposium, Boston, MA (United States), 2-6 Dec 1992). Order Number DE92008675. Source: OSTI; NTIS; GPO Dep.

Ferroelectric PZT 53:47 thin films were prepared by two different solution deposition methodologies. Both routes utilized carboxylate and alkoxide precursors and acetic acid, which served as both a solvent and a chemical modifier. We have studied the effects of solution preparation conditions on film microstructure and ferroelectric properties, and have used NMR spectroscopy to characterize chemical differences between the two precursor solutions. Films prepared by a sequential precursor addition (SPA) process were characterized by slightly lossy hysteresis loops, with a P_r of 18.7 $\mu C/cm^2$ and an E_c of 55.2 kV/cm. Films prepared by an inverted mixing order (IMO) process were characterized by well saturated hysteresis loops, a P_r of 26.2 $\mu C/cm^2$ and an E_c of 43.3 kV/cm. While NMR investigations indicated that the chemical environments of both the proton and carbon species were similar for the two processes, differences in the amounts of by-products (esters, and therefore, water) formed were noted. These differences apparently impacted ceramic microstructure. Although both films were characterized by a columnar growth morphology, the SPA derived film displayed a residual pyrochlore layer at the film surface, which did not transform into the stable perovskite phase. The presence of this layer resulted in poor dielectric properties and lossy ferroelectric behavior.

3662 (SAND–92-2006C) **Pressure as a probe of deep levels and defects in semiconductors: GaAs, GaP and their alloys.** Samara, G.A. Sandia National Labs., Albuquerque, NM (United States). [1992]. 6p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-76DP00789. (CONF-9208165–1: 5. international conference on high pressure in semiconductor physics, Kyoto (Japan), 18-21 Aug 1992). Order Number DE93000714. Source: OSTI; NTIS; GPO Dep.

Measurements of the effects of pressure on the thermal electron emission rate and capture cross section for a variety of deep electronic levels in GaAs, GaP and their alloys have yielded the pressure dependences of the energies of these levels in the bandgaps, allowed evaluation of the breathing mode lattice relaxations accompanying carrier emission or capture by these levels and revealed trends which lead to new insights into the nature of the responsible defects. Emphasis is on deep levels believed to be associated with simple defects. Specifically, results will be summarized for the donor levels of the dominant native defect known as EL2 in CAM, which is believed to be associated with the arsenic antisite, and on the radiation-induced El and E2 levels in GaAs, GaP and their alloys, which are believed to be due to arsenic (or phosphorous) vacancies. The results are discussed in terms of models for the defects responsible for these deep levels.

3663 (SAND–92-7294) **Electrical characterization of electrophoretically coated aluminum samples for photovoltaic concentrator application.** Sugimura, R.S. (Jet Propulsion Lab., Pasadena, CA (United States)); Mon, G.R.; Ross, R.G. Jr. Sandia National Labs., Albuquerque, NM (United States); Jet Propulsion Lab., Pasadena, CA (United States). Oct 1992. 31p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-76DP00789. Order Number DE93003229. Source: OSTI; NTIS; GPO Dep.

The practicality of using a thin-film styrene/acrylate copolymer electrophoretic coating to isolate concentrator cells electrically from their surroundings in a photovoltaic concentrator module is assessed. Only the electrical isolation problem was investigated. The approach was to subject various types of EP-coated aluminum specimens to electrical stress testing and to aging tests while monitoring coating electrical resistivity properties. It was determined that, in general, longer processing times–i.e., thicker electrophoretic layers–resulted in better voltage-withstand properties. In particular, a two-minute processing time seemed sufficient to provide the electrical isolation required in photovoltaic concentrator application applications. Even though electrophoretic coatings did not seem to fill voids in porous-anodized aluminum substrates, breakdown voltages generally exceeded hi-pot pass-fail voltage levels with a comfortable margin. 6 refs, 11 figs, 5 tabs.

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3664 (ANL/CHM/RP–77160) **Surveys of research in the Chemistry Division, Argonne National Laboratory.** Grazis, B.M. (ed.). Argonne National Lab., IL (United States). 1992. 220p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-31109-ENG-38. Order Number DE93002896. Source: OSTI; NTIS; GPO Dep.

Research reports are presented on reactive intermediates in condensed phase (radiation chemistry, photochemistry), electron transfer and energy conversion, photosynthesis and solar energy conversion, metal cluster chemistry, chemical dynamics in gas phase, photoionization-photoelectrons, characterization and reactivity of coal and coal macerals, premium coal sample program, chemical separations, heavy elements coordination chemistry, heavy elements photophysics/photochemistry, f-electron interactions, radiation chemistry of high-level wastes (gas generation in waste tanks), ultrafast molecular electronic devices, and nuclear medicine. Separate abstracts have been prepared. Accelerator activites and computer system/network services are also reported.

3665 (LA-UR–92-2914) **DOE methods compendium.** Leasure, C.S. Los Alamos National Lab., NM (United States). [1992]. 7p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. (CONF-920988–2: 19. annual National Energy and Environmental Quality Division of the American Society for Quality Control (ASQC)conference, Lake Buena Vista, FL (United States), 20-23 Sep 1992). Order Number DE93000800. Source: OSTI; NTIS; INIS; GPO Dep.

The Department of Energy (DOE) has established an analytical methods compendium development program to integrate its environmental analytical methods. This program is administered through DOE's Laboratory Management Division (EM-563). The primary objective of this program is to assemble a compendium of analytical chemistry methods of known performance for use by all DOE Environmental Restoration and Waste Management program. This compendium will include methods for sampling, field screening, fixed analytical laboratory and mobile analytical laboratory analyses. It will also include specific guidance on the proper selection of appropriate sampling and analytical methods in using specific analytical requirements.

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Refer also to citation(s) 2671, 2672, 2673, 2674, 2675, 2676, 2677, 2681, 2690, 2797, 2967, 3052, 3516, 3647, 3798, 3799, 3898, 3930, 3940, 4188, 4193, 4239, 4263

3666 (AECS-C/FRSR–56) **Inorganic ion exchanger based on heteropoly compounds of tetravalent metals.** Yassine, Taufik (Atomic Energy Commission, Damascus (Syrian Arab Republic)). Atomic Energy Commission, Damascus (Syrian Arab Republic). Jul 1992. 21p. (In Arabic). Order Number DE93606573. Source: OSTI; NTIS (US Sales Only); INIS.

A new amorphous inorganic ion exchanger, stannic silicomolybdate has been prepared and characterized by chemical analysis, x-ray and thermogravimetry. Chemical stability and each of exchange capacity and distribution coefficients for several ions were studied. The new exchanger has high selectivity for Cs^{+} in aqueous and organic solutions. The results were applied for separation of Cs^{+} from Sr^{++} and Cd^{2+} from $Ni^{2+}$and Zn^{2+}. (author). 10 refs., 12 figs., 10 tabs.

3667 (ANL/CP–77398) **Hard x-ray microimaging techniques based on phase zone plates.** Lai, B.; Yun, W.B.; Legnini, D.; Xiao, Y.H.; Chrzas, J. Argonne National Lab., IL (United States). [1992]. 6p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-31109-ENG-38. (CONF-920792–33: Society of Photo-Optical Instrumentation Engineers (SPIE) international symposium on optical applied science and engineering, San Diego, CA (United States), 19-24 Jul 1992). Order Number DE93000615. Source: OSTI; NTIS; INIS; GPO Dep.

Phase zone plates of high focusing efficiency and submicron resolution have been demonstrated in the hard x-ray region. A scanning microscope based on these focusing optics will create many new applications. Preliminary results in the applications of the microscope are reported here. In the area of imaging, we have utilized absorption contrast to clearly identify the locations of Au and Ni constituents in a sample of two interleaved grids. Micro-EXAFS spectra has also been obtained on a Ni foil. Fluorescence from a nuclear fuel sample, as an example of microanalysis, has revealed the elemental distribution at the interfaces. Lastly, microdiffraction from AgBr crystallites has been studied. 5 figs, 7 refs.

3668 (DOE/ER/13591–6) **Polymer-based separations: Synthesis and application of polymers for ionic and molecular recognition: Triennial performance report, August 1, 1989–July 31, 1992.** Alexandratos, S.D. Tennessee Univ., Knoxville, TN (United States). Jan 1992. 20p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG05-86ER13591. Order Number DE93001835. Source: OSTI; NTIS; GPO Dep.

Polymer-based separations have utilized resins such as sulfonic, acrylic, and iminodiacetic acid resins and the XAD series. Selective polymeric reagents for reaction with a targeted metal ion were synthesized as polymers with two different types of functional groups, each operating on the ions through a different mechanism. There are 3 classes of DMBPs (dual mechanism bifunctional polymers). Research during this period dealing with metal ion recognition focused on two of these classes (reduction of metal ions to metal; selective complexation).

3669 (DOE/ER/13996–3) **Hadamard transform imaging: Progress report, April 15, 1989–May 1, 1992.** Morris, M.D. Michigan Univ., Ann Arbor, MI (United States). Dept. of Chemistry. [1992]. 6p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG02-89ER13996. Order Number DE93002840. Source: OSTI; NTIS; GPO Dep.

We have constructed a Hadamard transform Raman microscopic imaging system, and have developed it to a high definition (64K pixel) technique. We have demonstrated multispectral Raman imaging and developed the first three-dimensional (digital confocal) Raman imaging. We have explored the systematic errors in Hadamard multiplexing techniques and developed corrections. We have used our Raman microscope techniques to explore defect distributions on graphite electrodes and damage effects on SERS-activated silver electrodes. We have used the microprobe capabilities of our instrument to investigate the kinetics of polyacrylamide formation in electrolysis capabilities. We have worked closely with a manufacture of holographic displays to develop and incorporate holographic filters and holographic beam splitters into Raman spectrographs and microscopes. Finally, we have developed Hadamard multiplexing techniques for densitometric measurements of protein or nucleic acid blots.

3670 (DOE/ID/13062–T1) **Development of phosphate-based ceramic membranes: Final report.** Anderson, M.A.; Zeltner, W.A.; Hill, C.G. Jr. Wisconsin Univ., Madison, WI (United States). Nov 1992. 67p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG07-91ID13062. Order Number DE93003285. Source: OSTI; NTIS; GPO Dep.

Goal was to develop microporous ceramic membranes by coating sols that contain nanoparticles onto porous ceramic supports. They could be used for either gas phase separations or liquid phase separations involving low molecular weight solutes. This required the synthesis of Sols containing particles in the range from 2 to 10 nm. Procedures for preparing nanoparticulate sols of silica, alumina, and aluminosilicates of various compositions are given. Unsupported ceramic membranes prepared from these sols had mean pore diameters of <10 Å (silica), ca. 35 Å (aluminosilicate). The alumina membranes display both microporosity (mean pore diameters <20 Å) and mesoporosity (mean pore diameters >20 Å). These nanoparticulate sols were deposited onto porous supports. Four methods of were investigated. Dip coating appeared to give the best performance of all of these techniques and was easily implemented. Deposition of particles within porous supports by permformation was also demonstrated. Critical point drying studies of membranes were initiated, but progress was limited. Slip casting could not be successfully used to produce a supported membrane free from cracks.

3671 (DOE/MC/26040–93/C0098) **Development of an electrochemical hydrogen separator.** Abens, S.; Fruchtman, J.;

Kush, A. Energy Research Corp., Danbury, CT (United States). [1992]. 11p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC21-89MC26040. (CONF-920951–7: US Department of Energy contractors review meeting on gasification and gas stream cleanup systems, Morgantown, WV (United States), 15-17 Sep 1992). Order Number DE93002606. Source: OSTI; NTIS; GPO Dep.

The electrochemical hydrogen separator (EHS), under development at ERC, has several attractive features: The operating temperature (150°C–200°C) is higher than those associated with the currently available devices and is compatible with the low temperature shift reactors. The EHS can operate at atmospheric as well as elevated pressures and the product H_2 is available at the feed stream pressure. High hydrogen recovery factor: 90% H_2 recovery from feed streams containing less than 10% hydrogen is feasible. High hydrogen purity: The product H_2 purity is >99% (dry basis) and is virtually independent of H_2 concentration in the feed gas. The process is continuous. Low energy cost: Depending upon the operating conditions, the energy requirement varies between 2 to 6 kWh/1000 SCF of recovered hydrogen.

3672 (DOE/PC/91288–T4) **High temperature electrochemical separation of H_2S from coal gasification process streams: Quarterly progress report, April 1, 1992–June 30, 1992.** Winnick, J. Georgia Inst. of Tech., Atlanta, GA (United States). School of Chemical Engineering. [1992]. 34p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG22-91PC91288. Order Number DE93000733. Source: OSTI; NTIS; GPO Dep.

An advanced process for the separation of hydrogen sulfide from coal gasification product streams through an electrochemical membrane is being developed using the funds from this grant. H_2S is removed from the syn-gas stream, split into hydrogen, which enriches the syn-gas, and sulfur, which can be condensed from an inert gas sweep stream. The process allows removal of H_2S without cooling the gas stream and with negligible pressure loss through the separator. The process is economically attractive by the lack of adsorbents and the lack of a Claus process for sulfur recovery. Research conducted during the present quarter is here highlighted, with an emphasis on progress towards the goal of an economically viable H_2S removal technology for use in coal gasification facilities providing polished fuel for co-generation coal fired electrical power facilities and Molten Carbonate Fuel Cell electrical power facilities.

3673 (IAEA-NAHRES–3) **Co-ordinated research programme on nuclear techniques for toxic elements in foodstuffs: Report on the third research co-ordination meeting, Jakarta, Indonesia, 20-24 November 1989.** International Atomic Energy Agency, Vienna (Austria). Section of Nutritional and Health-Related Environmental Studies. 1990. 184p. (CONF-8911339–: 3. research co-ordination meeting on nuclear techniques for toxic elements in foodstuffs, Jakarta (Indonesia), 20 Nov 1989). Order Number DE93606507. Source: OSTI; NTIS (US Sales Only); INIS.

This Co-ordinated Research Programme (CRP) was started by the Agency in 1985, within the framework of the Regional Cooperative Agreement for Research, Development and Training Related to Nuclear Science and Technology in the Asia and Pacific Region (RCA). Its main purpose has been to obtain comparative data on existing elemental concentrations of potentially toxic elements in foodstuffs in various Asian countries. The elements to be studied include the potentially most toxic trace elements (As, Cd, Hg, Pb, Se) as well as others of relevance to national monitoring programmes, such as Br, Cr, Cu, Fe, I, Mn, Sb, Tl, and Zn. An important supplementary purpose of the programme is to help establish analytical expertise for work of this kind in the individual countries. Scientists from several RCA Member States have participated in it, namely from Australia, Bangladesh, China, India, Indonesia, Japan, Malaysia, Pakistan, Thailand, and also from institutes in several countries outside the region, i.e., Argentina, Brazil, Jamaica and The Netherlands. This report summarizes the discussions that took place during the third and final Research Co-ordination Meeting (RCM) for the programme from 20-24 November 1989, in Jakarta, Indonesia. This document includes the progress reports presented by the participants as well as discussions and conclusions drawn from the meeting.

3674 (IAEA-NAHRES–3, pp. 16.1) **Leaching of industrial solid waste with special reference to the use of radioanalytical techniques.** Das, H.A. (Netherlands Energy Research Foundation (ECN), Petten (Netherlands)). International Atomic Energy Agency, Vienna (Austria). Section of Nutritional and Health-Related Environmental Studies. 1990. (CONF-8911339–: 3. research co-ordination meeting on nuclear techniques for toxic elements in foodstuffs, Jakarta (Indonesia), 20 Nov 1989). In *Co-ordinated research programme on nuclear techniques for toxic elements in foodstuffs: Report on the third research co-ordination meeting, Jakarta, Indonesia, 20-24 November 1989.* 184p. Order Number DE93606507. Source: OSTI; NTIS (US Sales Only); INIS.

Short communication. INDUSTRIAL WASTES/leaching; LEACHATES/neutron activation analysis; LEACHING; LEACHATES; QUANTITATIVE CHEMICAL ANALYSIS; REDOX POTENTIAL; SOLID WASTES

3675 (IAEA-NAHRES–3, pp. 11.1-11.11) **Trace element dietary assessment for the inhabitants of Gujranwala.** Qureshi, I.H. (Pakistan Inst. of Nuclear Science and Technology, Islamabad (Pakistan). Nuclear Chemistry Div.); Mannan, A.; Waheed, S.; Zaidi, J.H.; Arif, M. International Atomic Energy Agency, Vienna (Austria). Section of Nutritional and Health-Related Environmental Studies. 1990. (CONF-8911339–: 3. research co-ordination meeting on nuclear techniques for toxic elements in foodstuffs, Jakarta (Indonesia), 20 Nov 1989). In *Co-ordinated research programme on nuclear techniques for toxic elements in foodstuffs: Report on the third research co-ordination meeting, Jakarta, Indonesia, 20-24 November 1989.* 184p. Order Number DE93606507. Source: OSTI; NTIS (US Sales Only); INIS.

A study was undertaken for estimating the daily intake of toxic and other elements in the integrated diet of the residents of Gujranwala. The diet was prepared by taking into consideration the food habits of normal adults. The concentration of twenty-one elements were measured by neutron activation analysis and atomic absorption spectrophotometric techniques. Data indicates that the levels of the toxic elements in the integrated diet are generally higher than those of IAEA mixed human diet (H-9). The estimated intake values of toxic elements for the residents of Gujranwala are higher than that of the inhabitants of Islamabad areas but are within the suggested safe limits. In addition the prevailing concentration of several toxic elements were also measured in pulses and edible fats. Data of IAEA AQCS programme and external quality control were utilized to evaluate individual accuracy of the participating laboratories. (author). 13 refs, 6 tabs.

3676 (IAEA-NAHRES–3, pp. 12.1-12.6) **Analysis of toxic elements in food and drinking water by means of neutron activation analysis.** Leelhaphunt, N. (Office of Atomic Energy for Peace, Bangkok (Thailand)); Chueinta, S.; Punnachaiya, M.; Chueinta, W. International Atomic Energy Agency, Vienna (Austria). Section of Nutritional and Health-Related Environmental Studies. 1990. (CONF-8911339–: 3. research co-ordination meeting on nuclear techniques for toxic elements in foodstuffs, Jakarta (Indonesia), 20 Nov 1989). In *Co-ordinated research programme on nuclear techniques for toxic elements in foodstuffs: Report on the third research co-ordination meeting, Jakarta, Indonesia, 20-24 November 1989.* 184p. Order Number DE93606507. Source: OSTI; NTIS (US Sales Only); INIS.

From the view point of environmental safety assessment if is important to find out the information of the levels of toxic elements in foodstuffs for human consumption so as to establish the maximum permissible concentrations of dietary intake of toxic elements for Thai people. The research work included the development of a proper technique for the determination of Ag, As, Br, Cd, Co, Cr, Cu, Fe, Hg, Mn, Sb, Sc, Se, U, V and Zn, management of appropriate sample preparation technique, and investigation of the amount of Ag, As, Br, Cd, Co, Cr, Cu, Fe, Hg, Mn, Sb, Sc, Se, U, V and Zn in various kinds of vegetables, meat and poultry, various kinds of seafood, fish and drinking water. 7 refs, 3 tabs.

3677 (IAEA-NAHRES–3, pp. 13.1-13.4) **NAA and/or ICP-MS for the determination of trace elements in biological materials?.** Fardy, J.J. (Australian Nuclear Science and Technology Organization (ANSTO), Menai (Australia). Isotope Technology Program); Warner, I.M. International Atomic Energy Agency, Vienna

(Austria). Section of Nutritional and Health-Related Environmental Studies. 1990. (CONF-8911339–: 3. research co-ordination meeting on nuclear techniques for toxic elements in foodstuffs, Jakarta (Indonesia), 20 Nov 1989). In *Co-ordinated research programme on nuclear techniques for toxic elements in foodstuffs: Report on the third research co-ordination meeting, Jakarta, Indonesia, 20-24 November 1989.* 184p. Order Number DE93606507. Source: OSTI; NTIS (US Sales Only); INIS.

The IAEA Standard Reference Material, Mixed Human Diet, H-9, was analysed by all techniques and their performance and limitations evaluated under normal, routine, multi-element surveys of a large number of biological materials. This paper reports the result of this study. NAA cannot match the superior sensitivity for a wider range of elements obtained by ICP-MS. This has been verified for a wide range of food samples. While NAA is an inconvenient and time-consuming technique for many applications, it does not suffer from blank problems after irradiation of the sample, and becomes the preferred technique where low limits of detection are required for trace concentrations in solid samples. 8 refs.

3678 (IAEA-NAHRES–3, pp. 3.1-3.22) **Neutron activation analysis of toxic elements in meat and farinaceous food of Argentina.** Resnizky, S.M. (Gerencia de Area Radioisotopos y Radiaciones, Buenos Aires (Argentina). Comision Nacional de Energia Atomica); Bertini, L.M.; Moreno, M.A.; Piedracoba, N.V. de. International Atomic Energy Agency, Vienna (Austria). Section of Nutritional and Health-Related Environmental Studies. 1990. (CONF-8911339–: 3. research co-ordination meeting on nuclear techniques for toxic elements in foodstuffs, Jakarta (Indonesia), 20 Nov 1989). In *Co-ordinated research programme on nuclear techniques for toxic elements in foodstuffs: Report on the third research co-ordination meeting, Jakarta, Indonesia, 20-24 November 1989.* 184p. Order Number DE93606507. Source: OSTI; NTIS (US Sales Only); INIS.

Quantitative information about the concentration of toxic elements in foodstuffs for human consumption is important for the study of human health and diseases. Our project is to analyze, by neutron activation, toxic elements im meat and farinaceous food of Argentina by means of: a) Radiochemical neutron activation analysis with development of an adequate technique for the determination of As, Se, Sb and Hg in farinaceous food and manufactured meat (sausages and hamburgers); b) Instrumental neutron activation analysis of Rb, Se, Br, Fe, Co and Zn in farinaceous food and manufactured meat; c) Preliminary studies of the daily intake of the determined elements. 5 refs, 3 figs, 17 tabs.

3679 (IAEA-NAHRES–3, pp. 4.1-4.45) **Application of neutron activation analysis and inductively coupled plasma mass spectrometry to the determination of toxic and essential elements in Australian foods.** Fardy, J.J. (Australian Nuclear Science and Technology Organisation (ANSTO), Menai (Australia). Isotope Technology Program); McOrist, G.D.; Bowles, C.J.; Farrar, Y.J.; Warner, I.M. International Atomic Energy Agency, Vienna (Austria). Section of Nutritional and Health-Related Environmental Studies. 1990. (CONF-8911339–: 3. research co-ordination meeting on nuclear techniques for toxic elements in foodstuffs, Jakarta (Indonesia), 20 Nov 1989). In *Co-ordinated research programme on nuclear techniques for toxic elements in foodstuffs: Report on the third research co-ordination meeting, Jakarta, Indonesia, 20-24 November 1989.* 184p. Order Number DE93606507. Source: OSTI; NTIS (US Sales Only); INIS.

Current Australian legislation specifies the maximum permitted levels of nine toxic elements in foods while the National Health and Medical Research Council (NH and NRC) has listed recommended daily intake figures for seven essential elements. This investigation examined the compliance of Australian foods with both these requirements. Australia-wide samples of representative foods from the diets of Australians were used in this study after the NH and NRC kindly permitted us to join their Market Basket (Noxious Substance) Survey. Both toxic and essential element concentrations in these foods were determined using the advanced analytical techniques of instrumental and radiochemical neutron activation analysis and inductively coupled plasma mass spectrometry. With very few exceptions foods do not exceed the maximum, permitted levels for toxic substances. Daily intake figures for essential elements generally lie close to the maximum recommended values listed by NH and NRC. (author). 11 refs, 22 figs, 17 tabs.

3680 (IAEA-NAHRES–3, pp. 5.1-5.11) **Application of neutron activation analysis to the monitoring of trace elements in Brazilian foodstuffs.** Vasconcellos, M.B.A. (Instituto de Pesquisas Energeticas e Nucleares (IPEN), Sao Paulo, SP (Brazil)); Maihara, V.A.; Munita, C.S.; Favaro, D.I.T.; Armelin, M.J.A.; Cortes, E.; Ogris, R. International Atomic Energy Agency, Vienna (Austria). Section of Nutritional and Health-Related Environmental Studies. 1990. (CONF-8911339–: 3. research co-ordination meeting on nuclear techniques for toxic elements in foodstuffs, Jakarta (Indonesia), 20 Nov 1989). In *Co-ordinated research programme on nuclear techniques for toxic elements in foodstuffs: Report on the third research co-ordination meeting, Jakarta, Indonesia, 20-24 November 1989.* 184p. Order Number DE93606507. Source: OSTI; NTIS (US Sales Only); INIS.

The aim of the work on NAA of Brazilian foodstuffs this year was to develop reliably radiochemical methods that would be faster than the previously utilized procedure for Hg and Se, based on distillation and precipitation. For sample dissolution, teflon bombs were utilized, using conventional and also microwave ovens. The main elements studied were Hg, Se, As, Sb and the methods of separation employed were ion-exchange, retention in inorganic exchangers and solvent extraction. The procedures employed were applied to the analysis of the reference materials Bowen's Kale, Citrus Leaves (NBS-SRM-1572), Rice Flour (NBS-SRM-1568), Copepod (IAEA-MA-A-1), Mussel Tissue (IAEA-MA-M-2), Oyster Tissue (NBS-SRM-1566) and Fresh Water (IAEA-W-4). 14 refs, 4 tabs.

3681 (IAEA-NAHRES–3, pp. 6.1-6.11) **Application of nuclear techniques for determining toxic elements in Chinese foodstuffs.** Sun Laiyan (Institute for Application of Atomic Energy, Beijing (China)); Lu Fengying; Su Rongwei; Zhen Houxi. International Atomic Energy Agency, Vienna (Austria). Section of Nutritional and Health-Related Environmental Studies. 1990. (CONF-8911339–: 3. research co-ordination meeting on nuclear techniques for toxic elements in foodstuffs, Jakarta (Indonesia), 20 Nov 1989). In *Co-ordinated research programme on nuclear techniques for toxic elements in foodstuffs: Report on the third research co-ordination meeting, Jakarta, Indonesia, 20-24 November 1989.* 184p. Order Number DE93606507. Source: OSTI; NTIS (US Sales Only); INIS.

The concentrations of elements As, Br, Cd, Cr, Cu, Hg, Pb, Sb, Se and Zn in foodstuffs collected from some main Chinese cities were determined by Instrumental and radiochemical neutron activation analysis as well as atomic absorption spectrometric methods. More than 100 samples included 20-25 kinds of main foodstuffs were analyzed in each city. The results are given in tables and compared with the maximum permissible concentration (MLC). The contents in almost all of the samples were much less or less than the MPC. A few samples with higher As, Cd and Pb contents were found. The dietary intake of toxic elements for population groups concerned was calculated according to the person's average dietary intake and determined values of toxic elements in foodstuffs. All the results are within the safety ranges. 6 refs, 1 fig., 5 tabs.

3682 (IAEA-NAHRES–3, pp. 7.1-7.9) **Determination of toxic and essential elements in seafood.** Surtipanti, S. (National Atomic Energy Agency, Jakarta (Indonesia). Center for Applications of Isotopes and Radiation); Suwirma, S.; Yumiarti, S.; Yune Mellawati, T. International Atomic Energy Agency, Vienna (Austria). Section of Nutritional and Health-Related Environmental Studies. 1990. (CONF-8911339–: 3. research co-ordination meeting on nuclear techniques for toxic elements in foodstuffs, Jakarta (Indonesia), 20 Nov 1989). In *Co-ordinated research programme on nuclear techniques for toxic elements in foodstuffs: Report on the third research co-ordination meeting, Jakarta, Indonesia, 20-24 November 1989.* 184p. Order Number DE93606507. Source: OSTI; NTIS (US Sales Only); INIS.

Indonesia has only a list of the maximum permissible concentration of toxic elements in water stated in a national legislation. Therefore, it is important to study the toxic elements content in fish and shellfish, because these marine organisms are good biological

indicators. The interesting elements to be analyzed are toxic elements, i.e. As, Cd, Cr, Hg, Pb, Sb and Se, and essential elements, i.e., Zn and Cu. As, Cr, Hg, Sb, Se and Zn can be determined by Neutron Activation Analysis (NAA), while Cd, Cu and Pb by Atomic Absorption Spectrometry (AAS). The determination of such elements in foodstuff i.e. rice, corn, green pea, wheat, vegetables, fruits, tea and coffee have been done previously. The major purpose of this work is to know whether the concentration of toxic elements in marine organisms is approaching or exceeding the maximum permissible concentration as stated by International legislation. 7 refs, 5 tabs.

3683 (IAEA-NAHRES–3, pp. 8.1-8.9) **Toxic and trace elements in foodstuffs in Japan.** Muramatsu, Y. (National Inst. of Radiological Sciences, Ibaraki (Japan)); Sumiya, N.; Yanagisawa, H.K.; Ohmomo, Y. International Atomic Energy Agency, Vienna (Austria). Section of Nutritional and Health-Related Environmental Studies. 1990. (CONF-8911339–: 3. research co-ordination meeting on nuclear techniques for toxic elements in foodstuffs, Jakarta (Indonesia), 20 Nov 1989). In *Co-ordinated research programme on nuclear techniques for toxic elements in foodstuffs: Report on the third research co-ordination meeting, Jakarta, Indonesia, 20-24 November 1989.* 184p. Order Number DE93606507. Source: OSTI; NTIS (US Sales Only); INIS.

Concentrations of trace elements in several foodstuffs collected in Ibaraki-Prefecture, Japan, have been analyzed by neutron activation analysis (NAA), inductively-coupled plasma atomic emission spectrometry (ICP-AES) and anodic striping voltametry, (ASV). The elements analyzed were as follows: Zn, Se, As, Hg, Cs, Cr, Co, Fe, Rb, Br and K by NAA; Mn, Ba, Sr, Mg, Ca, P, K, Zn, Cu and Fe by ICP-AES; and Pb, Cd, Cu and Zn by ASV. Dietary intake of As, Ca, Cd, Cu, Hg, K, Mg, Mn, P, Pb, Se and Zn by Japanese were estimated by using these analytical results and published food consumption data in Japan. (author). 6 refs, 4 tabs.

3684 (IAEA-NAHRES–3, pp. 9.1-9.13) **Application of neutron activation analysis to the determination of toxic elements in Malaysia foodstuffs.** Hamzah, Z.B. (PUSPATI Complex, Bangi, Selangor (Malaysia). Nuclear Energy Unit). International Atomic Energy Agency, Vienna (Austria). Section of Nutritional and Health-Related Environmental Studies. 1990. (CONF-8911339–: 3. research co-ordination meeting on nuclear techniques for toxic elements in foodstuffs, Jakarta (Indonesia), 20 Nov 1989). In *Co-ordinated research programme on nuclear techniques for toxic elements in foodstuffs: Report on the third research co-ordination meeting, Jakarta, Indonesia, 20-24 November 1989.* 184p. Order Number DE93606507. Source: OSTI; NTIS (US Sales Only); INIS.

The main activities for last year were on the analysis of toxic elements in vegetables, milk and poultry samples. At the same time works on the radiochemical separation were conducted as most of these samples contain less amount of toxic elements of interest. The separation technique for As was established i.e. precipitation method. This method apparently gives a good recovery. As for Sb, Se and Hg we are still studying the best separation techniques. 5 tabs.

3685 (IAEA-NAHRES–5) **Intercomparison of enriched stable isotope reference materials for medical and biological studies.** Parr, R.M.; Clements, S.A. International Atomic Energy Agency, Vienna (Austria). Section of Nutritional and Health-Related Environmental Studies. 1991. 31p. Order Number DE93606549. Source: OSTI; NTIS (US Sales Only); INIS.

This report summarizes the results of an intercomparison exercise organized by the IAEA during the latter part of 1988 and 1989. Data are presented for 13 different kinds of enriched stable isotope reference material containing ^{2}H, ^{13}C, ^{15}N and ^{18}O. Results were submitted by forty participants in twenty countries. 2 refs, 13 figs, 18 tabs.

3686 (IAEA-NAHRES–6) **Co-ordinated research programme on the use of nuclear and nuclear-related techniques in the study of environmental pollution associated with solid wastes: Report on the second research co-ordination meeting, Jakarta, Indonesia, 20-24 November 1989.** International Atomic Energy Agency, Vienna (Austria). Section of Nutritional and Health-Related Environmental Studies. 1991. 233p. (CONF-8911338–: 2. research co-ordination meeting on the use of nuclear and nuclear-related techniques in the study of environmental pollution associated with solid wastes, JAKARTA (Indonesia), 20-24 Nov 1989). Order Number DE93606508. Source: OSTI; NTIS (US Sales Only); INIS.

A co-ordinated research programme on the use of nuclear and nuclear-related techniques in the study of environmental pollution associated with solid wastes was started by the IAEA in December 1987 and now comprises twenty-three participants from twenty-one countries. Topics of interest in this programme include studies of atmospheric aerosols, coal fly ash, incinerator ash, sewage sludge and a variety of other environmental specimens contaminated with solid wastes. The analytical techniques used include neutron activation analysis, particle-induced X-ray emission and energy-dispersive X-ray fluorescence. This report summarizes the discussions that took place during the second research co-ordination meeting. Working papers presented by the participants are included as annexes and have been indexed separately. Refs, figs and tabs.

3687 (IAEA-NAHRES–6, pp. 14-1-14-14) **The use of neutron activation analysis for the study of environmental risks associated with the fly ash from burning Polish coals.** Dybczynski, R. (Institute of Nuclear Chemistry and Technology, Warsaw (Poland). Dept. of Analytical Chemistry); Kulisa, K.; Malusecka, M.; Mandecka, M.; Polkowska Motrenko, H.; Samczynski, Z.; Szopa, Z.; Tenerowicz, B. International Atomic Energy Agency, Vienna (Austria). Section of Nutritional and Health-Related Environmental Studies. 1991. (CONF-8911338–: 2. research co-ordination meeting on the use of nuclear and nuclear-related techniques in the study of environmental pollution asociated with solid wastes, JAKARTA (Indonesia), 20 Nov 1989). In *Co-ordinated research programme on the use of nuclear and nuclear-related techniques in the study of environmental pollution associated with solid wastes: Report on the second research co-ordination meeting, Jakarta, Indonesia, 20-24 November 1989.* 233p. Order Number DE93606508. Source: OSTI; NTIS (US Sales Only); INIS.

The work oriented towards assessment of environmental risk associated with the emission of fly-ash into atmosphere and its storage on solid waste depositories included: 1. Elaboration of the INAA procedure for the determination of 20-24 elements in the fly-ashes. This method was next used for the analysis of fly-ashes from three different Polish power stations working on hard coal. 2. Studies on leaching of trace elements from neutron irradiated fly-ash by water and H_2SO_4 solution (pH=2.5) simulating acid rain. The results were compared with analogous experiments in which elements leached from non-irradiated fly-ash were determined by AAS and spectrophotometry. 3. Preparation and certification on the basis of an international intercomparison of the new Polish CRM - fine fly-ash (CTA-FFA-1). Although the certification is still not completed it is almost certain that it will be possible to establish "recommended values" for at least 34 elements and "information values" for another 10 to 16 ones. (author). 11 refs, 5 figs, 4 tabs.

3688 (IAEA-NAHRES–6, pp. 10.1-10.6) **Assessment of heavy metal pollution in Ghana by nuclear-related techniques.** Bamford, S.A. (Ghana Atomic Energy Commission, Accra (Ghana). National Nuclear Research Inst.); Biney, C.A. International Atomic Energy Agency, Vienna (Austria). Section of Nutritional and Health-Related Environmental Studies. 1991. (CONF-8911338–: 2. research co-ordination meeting on the use of nuclear and nuclear-related techniques in the study of environmental pollution asociated with solid wastes, JAKARTA (Indonesia), 20 Nov 1989). In *Co-ordinated research programme on the use of nuclear and nuclear-related techniques in the study of environmental pollution associated with solid wastes: Report on the second research co-ordination meeting, Jakarta, Indonesia, 20-24 November 1989.* 233p. Order Number DE93606508. Source: OSTI; NTIS (US Sales Only); INIS.

An on-going study is being carried out to investigate the impact of gold mining in Ghana on the environment. The pollution sources identified include, among others, the gold ore, gold tailings, and gaseous emissions. The presence and levels of heavy metals in gold ore, gold tailings, and inland waters from two of the gold mines have been determined using ED-XRF and AAS techniques. The heavy metals identified in the solid samples were Cr, Mn, Fe,

Cu, Zn, As, Pb and Zr within a concentration range of 0.08 mg/kg - 4.9%. The inland waters (ponds, rivers, etc.) however showed the presence of only Fe and Zn at levels of 0.08 - 2.4 ug/ml. (author). 7 refs, 3 figs, 3 tabs.

3689 (IAEA-NAHRES–6, pp. 11.1-11.3) **Toxic elements in air particulate matter in the area of Thessaloniki, Greece.** Misaelides, P. (Thessaloniki Univ., Thessaloniki (Greece). Dept. of Chemistry); Samara, C.; Kouimtziz, T. International Atomic Energy Agency, Vienna (Austria). Section of Nutritional and Health-Related Environmental Studies. 1991. (CONF-8911338–: 2. research co-ordination meeting on the use of nuclear and nuclear-related techniques in the study of environmental pollution asociated with solid wastes, JAKARTA (Indonesia), 20 Nov 1989). In *Co-ordinated research programme on the use of nuclear and nuclear-related techniques in the study of environmental pollution associated with solid wastes: Report on the second research co-ordination meeting, Jakarta, Indonesia, 20-24 November 1989.* 233p. Order Number DE93606508. Source: OSTI; NTIS (US Sales Only); INIS.

Neutron activation analysis and high-resolution X-ray spectrometry were used to analyse total suspended particulates from urban and rural areas of Thessaloniki. Higher concentrations for most of the elements studied were observed during sampling periods with north or north-west winds. This can be attributed to the presence of a heavily polluted industrial area at the northern and north-western part of the city. It is hoped to apply receptor modelling to identify pollution sources. 1 fig., 1 tab.

3690 (IAEA-NAHRES–6, pp. 12.1-12.20) **Behaviour and distribution of toxic elements in fly-ash particulates.** Rausch, H. (Hungarian Academy of Sciences, Budapest (Hungary). Central Research Inst. for Physics); Baranyai Fliszar, R.; Kunstar, M.; Sziklai Laszlo, I.; Torok, S.; Zemplen Papp, E. International Atomic Energy Agency, Vienna (Austria). Section of Nutritional and Health-Related Environmental Studies. 1991. (CONF-8911338–: 2. research co-ordination meeting on the use of nuclear and nuclear-related techniques in the study of environmental pollution asociated with solid wastes, JAKARTA (Indonesia), 20-24 Nov 1989). In *Co-ordinated research programme on the use of nuclear and nuclear-related techniques in the study of environmental pollution associated with solid wastes: Report on the second research co-ordination meeting, Jakarta, Indonesia, 20-24 November 1989.* 233p. Order Number DE93606508. Source: OSTI; NTIS (US Sales Only); INIS.

This report describes an investigation of the by-products of combustion of brown coal and lignite in the four main power stations in Hungary. The aim of the research is to study the behaviour and distribution of toxic components within the various species of fly-ash substances differentiated by sample location and fractionation. The results are expected to yield answers to some fundamental questions regarding environmental pollution by fly-ash. 11 refs, 9 figs, 5 tabs.

3691 (IAEA-NAHRES–6, pp. 13.1-13.6) **Environmental impact assessment of coal fired thermal power plants.** Sadasivan, S. (Bhabha Atomic Research Centre, Bombay (India)); Negi, B.S.; Menon, M.R. International Atomic Energy Agency, Vienna (Austria). Section of Nutritional and Health-Related Environmental Studies. 1991. (CONF-8911338–: 2. research co-ordination meeting on the use of nuclear and nuclear-related techniques in the study of environmental pollution asociated with solid wastes, JAKARTA (Indonesia), 20-24 Nov 1989). In *Co-ordinated research programme on the use of nuclear and nuclear-related techniques in the study of environmental pollution associated with solid wastes: Report on the second research co-ordination meeting, Jakarta, Indonesia, 20-24 November 1989.* 233p. Order Number DE93606508. Source: OSTI; NTIS (US Sales Only); INIS.

The results of analysis of coal, bottom ash, ESP ash and fly ash from stacks obtained from some thermal power stations in India are presented and discussed. Some elements in the fly ash collected from stack tended to show an enrichment over the electrostatic precipitator (ESP) ash. The natural radioactivity in these samples were also measured by gamma spectrometry. The size distribution of fly ash samples were studied. By using available software an idea of the magnitude of deposition of various elements released from stacks were obtained for a typical Indian city. The Polish candidate fly ash and air filter samples for intercomparison were also analyzed. (author). 11 refs, 4 tabs.

3692 (IAEA-NAHRES–6, pp. 15.1-15.5) **The environmental implications of lignite ash on water qualities.** Somboon, W. (Chulalongkorn Univ., Bangkok (Thailand). Inst. of Environmental Research); Sumitra, T.; Yamkate, P.; Khantaprab, C. International Atomic Energy Agency, Vienna (Austria). Section of Nutritional and Health-Related Environmental Studies. 1991. (CONF-8911338–: 2. research co-ordination meeting on the use of nuclear and nuclear-related techniques in the study of environmental pollution asociated with solid wastes, JAKARTA (Indonesia), 20-24 Nov 1989). In *Co-ordinated research programme on the use of nuclear and nuclear-related techniques in the study of environmental pollution associated with solid wastes: Report on the second research co-ordination meeting, Jakarta, Indonesia, 20-24 November 1989.* 233p. Order Number DE93606508. Source: OSTI; NTIS (US Sales Only); INIS.

Impact of metals from lignite and lignite power plants activities on surface and ground water, and rain water was studied. Water samples and water mud were collected twice a year during the dry and wet season for a period of one year. Data from dry period showed impact of As, Hg, Fe, Ni and Zn an surface water while As, Hg and Ni had contaminated ground water and rain water. (author). 2 figs, 3 tabs.

3693 (IAEA-NAHRES–6, pp. 16.1-16.21) **Determination of atmospheric trace elements by INAA: An application of receptor modelling.** Tuncel, G. (Middle East Technical Univ., Ankara (Turkey)); Aras, N.K.; Tuncel, S.G.; Yatin, M. International Atomic Energy Agency, Vienna (Austria). Section of Nutritional and Health-Related Environmental Studies. 1991. (CONF-8911338–: 2. research co-ordination meeting on the use of nuclear and nuclear-related techniques in the study of environmental pollution asociated with solid wastes, JAKARTA (Indonesia), 20 Nov 1989). In *Co-ordinated research programme on the use of nuclear and nuclear-related techniques in the study of environmental pollution associated with solid wastes: Report on the second research co-ordination meeting, Jakarta, Indonesia, 20-24 November 1989.* 233p. Order Number DE93606508. Source: OSTI; NTIS (US Sales Only); INIS.

The aim of this work is to estimate the sources contributing to the ambient concentrations of polluting particles in the area of Ankara. This will be done by a statistical analysis of trace element data from ambient samples. 14 refs, 6 figs, 5 tabs.

3694 (IAEA-NAHRES–6, pp. 17.1-17.11) **The K_0 - standardization method of NAA as a tool for studying environmental pollution problems.** Stegnar, P. (Institut Jozef Stefan, Ljubljana (Yugoslavia)); Smodis, B.; Jacimovic, R. International Atomic Energy Agency, Vienna (Austria). Section of Nutritional and Health-Related Environmental Studies. 1991. (CONF-8911338–: 2. research co-ordination meeting on the use of nuclear and nuclear-related techniques in the study of environmental pollution asociated with solid wastes, JAKARTA (Indonesia), 20 Nov 1989). In *Co-ordinated research programme on the use of nuclear and nuclear-related techniques in the study of environmental pollution associated with solid wastes: Report on the second research co-ordination meeting, Jakarta, Indonesia, 20-24 November 1989.* 233p. Order Number DE93606508. Source: OSTI; NTIS (US Sales Only); INIS.

An increasing interest has been manifested during recent years in the determination of trace elements in environmental materials in relation to ecological studies. In this respect NAA plays an important role due its accuracy, sensitivity and specificity. However, in most cases the relative method is used, requiring standards for each element determined. The demand for multielement analyses enhanced the need for an absolute method. Unfortunately, this requires an arbitrarily selected nuclear data set, thus introducing corresponding uncertainties in the results. In the period 1973-1987 a new approach, named the K_0 - method, was developed at the Institute for Nuclear Sciences, Gent, Belgium. It is essentially an absolute technique where the uncertain nuclear constants are replaced by compound nuclear constants, the K_0 - factors. These factors, which characterize the nuclides, were experimentally determined with high accuracy by the authors of the method. During

1987/1988, the K_0 - standardization method was implemented at the "J. Stefan" Institute in Ljubljana, Yugoslavia. Investigation of NIST standard reference materials SRM 1570 Spinach, SRM 1571 Orchard Leaves, SRM 1572 Citrus Leaves and SRM 1573 Tomato Leaves showed that the systematic error in determining twelve certified elements was less than 8 %. IAEA CRM SL1 Lake Sediment, NIST SRM 2704 Buffalo River Sediment and SRM 1633a Coal Fly Ash were also analysed. A series of environmental samples such as sediments, soils, electrostatically separated fly ash and selected lichens as biological indicators for atmospheric pollution were analysed for approximately 50 elements, and some of the results will be presented. (author). 3 figs, 4 tabs.

3695 (IAEA-NAHRES–6, pp. 18.1-18.7) **Application of x-ray emission spectroscopy in evaluating the environmental impact of coal burning power plants.** Jaksic, N. (Institut Rudjer Boskovic, Zagreb (Yugoslavia)); Valkovic, V. International Atomic Energy Agency, Vienna (Austria). Section of Nutritional and Health-Related Environmental Studies. 1991. (CONF-8911338–: 2. research co-ordination meeting on the use of nuclear and nuclear-related techniques in the study of environmental pollution asociated with solid wastes, JAKARTA (Indonesia), 20 Nov 1989). In *Co-ordinated research programme on the use of nuclear and nuclear-related techniques in the study of environmental pollution associated with solid wastes: Report on the second research co-ordination meeting, Jakarta, Indonesia, 20-24 November 1989.* 233p. Order Number DE93606508. Source: OSTI; NTIS (US Sales Only); INIS.

The relatively high concentration of sulphur and trace elements measured in coal makes the environmental impact study of the coal burning Power plant Plomin I very important. The results of XRF and PIXE measurements of both coal and ash (fly and bottom) composition served as a basis for the study of dynamic properties of trace elements. The quantities of pollutants were found to be dependent on the initial composition of coal. The pollution control at the plant is found to be also of great importance. Elements like titanium, vanadium and uranium are concentrated in fly ash. On the other side selenium is concentrated in the flue gases and intensively leached by the rainwater from the ash disposal site. Further development of nuclear analytical methods at the Tandem Van de Graft accelerator facility were made. Radiological impact study and study of ground water contamination are now in progress. (author). 7 refs, 2 figs, 3 tabs.

3696 (IAEA-NAHRES–6, pp. 19.1-19.9) **Environmental pollution studies in Vietnam based on analysis of atmospheric aerosols and sediments by NAA and AAS.** Tran Van Luyen (DALAT Nuclear Research Inst., Dinh Tien Hoang Dalat (Viet Nam)). International Atomic Energy Agency, Vienna (Austria). Section of Nutritional and Health-Related Environmental Studies. 1991. (CONF-8911338–: 2. research co-ordination meeting on the use of nuclear and nuclear-related techniques in the study of environmental pollution asociated with solid wastes, JAKARTA (Indonesia), 20 Nov 1989). In *Co-ordinated research programme on the use of nuclear and nuclear-related techniques in the study of environmental pollution associated with solid wastes: Report on the second research co-ordination meeting, Jakarta, Indonesia, 20-24 November 1989.* 233p. Order Number DE93606508. Source: OSTI; NTIS (US Sales Only); INIS.

By setting up sampling stations in HoChiMinh City and Dalat the atmospheric aerosol, rain water, sediments and other samples are being collected monthly. The concentrations of major and trace elements in the collected samples were determined by INAA and XRF techniques. These techniques are suitable for analyzing up to 28 elements under our laboratory conditions. The detection of elements in aerosol samples was limited by the presence of these elements in the filter materials. The trace element concentrations in these filters have been determined and the results are also presented in the report. 2 refs, 2 figs, 5 tabs.

3697 (IAEA-NAHRES–6, pp. 20.1-20.11) **Air quality status in Kinshasa as determined by instrumental neutron activation analysis, atomic absorption spectrometry and ion-exchange chromatography.** Lobo, K.K. (Kinshasa Univ., Kinshasa (Zaire). Faculte des Sciences); Tshiashala, M.C.; Lumu, B.M.; Matamba, K.; Ronneau, C. International Atomic Energy Agency, Vienna (Austria). Section of Nutritional and Health-Related Environmental Studies. 1991. (CONF-8911338–: 2. research co-ordination meeting on the use of nuclear and nuclear-related techniques in the study of environmental pollution asociated with solid wastes, JAKARTA (Indonesia), 20 Nov 1989). In *Co-ordinated research programme on the use of nuclear and nuclear-related techniques in the study of environmental pollution associated with solid wastes: Report on the second research co-ordination meeting, Jakarta, Indonesia, 20-24 November 1989.* 233p. Order Number DE93606508. Source: OSTI; NTIS (US Sales Only); INIS.

Three independent analytical techniques - instrumental neutron activation analysis. Atomic absorption spectrometry and ion-exchange chromatography - were applied to airborne particulate collected on filters and to atmospheric acid gases collected in carbonate buffer solutions. 20 trace elements and 7 acid gases and acid aerosols were determined. Results were compared with those observed elsewhere and showed that air pollution is low in Kinshasa and does not give rise to anxieties. The main known sources of pollutants are: vehicle exhaust and aeolian process on stripped soils. (author). 13 refs, 2 figs, 6 tabs.

3698 (IAEA-NAHRES–6, pp. 21.1-21.14) **Environmental impact of toxic elements leached from waste disposal of coal power plants.** Yatim, S. (National Atomic Energy Agency, Serpong, West Java (Indonesia). Centre for the Radwaste Management Technology). International Atomic Energy Agency, Vienna (Austria). Section of Nutritional and Health-Related Environmental Studies. 1991. (CONF-8911338–: 2. research co-ordination meeting on the use of nuclear and nuclear-related techniques in the study of environmental pollution asociated with solid wastes, JAKARTA (Indonesia), 20 Nov 1989). In *Co-ordinated research programme on the use of nuclear and nuclear-related techniques in the study of environmental pollution associated with solid wastes: Report on the second research co-ordination meeting, Jakarta, Indonesia, 20-24 November 1989.* 233p. Order Number DE93606508. Source: OSTI; NTIS (US Sales Only); INIS.

The study being carried out is focused on the environmental pollution of the leached toxic elements from the waste disposal of coal power plants and covered the following works: 1. Analysis the presence of toxic elements and the natural radioactivity in coal, ash and the ash in a waste disposal area. 2. Leaching study. 3. Analysis the presence of a toxic heavy metals and natural radionuclides in the environmental samples in the vicinity of the waste disposal area. Prediction on the transport model of the leached elements in the local ecosystem and its long-term impact. Analysis of the heavy elements were carried by INAA technique and the total alpha and beta activity in the samples were analyzed by GM-flow detector. "A standard leaching test for combustion residues (BEOP-31)", developed by The Netherlands Energy Research Foundation was adopted in the leaching study and used in the prediction of environmental impact of leached heavy metals from the waste. 2 refs, 9 figs, 4 tabs.

3699 (IAEA-NAHRES–6, pp. 22.1-22.13) **Atmospheric trace elements in gaseous and small size particles forms.** Kist, A.A. (AN Uzbekskoj SSR, Tashkent (Uzbekistan). Inst. Yadernoj Fiziki); Kist, An.A.; Zhuk, L.I. International Atomic Energy Agency, Vienna (Austria). Section of Nutritional and Health-Related Environmental Studies. 1991. (CONF-8911338–: 2. research co-ordination meeting on the use of nuclear and nuclear-related techniques in the study of environmental pollution asociated with solid wastes, JAKARTA (Indonesia), 20 Nov 1989). In *Co-ordinated research programme on the use of nuclear and nuclear-related techniques in the study of environmental pollution associated with solid wastes: Report on the second research co-ordination meeting, Jakarta, Indonesia, 20-24 November 1989.* 233p. Order Number DE93606508. Source: OSTI; NTIS (US Sales Only); INIS.

A number of advantages are associated with investigating atmospheric composition by sampling vapour-gas and submicron aerosol phases. Passive sorption may be an appropriate sampling technique. Determination of trace element composition represents an important problem in view of the possible identification of their sources, and will also lead to a better understanding of their migration, interaction with other forms of pollution and their actions. 11 refs, 2 figs, 7 tabs.

3700 (IAEA-NAHRES–6, pp. 3.1-3.20) **Monitoring of heavy pollutants from industrial emissions and effluents.** Khan, A.H. (Atomic Energy Centre, Dhaka (Bangladesh). Trace Analysis Lab.). International Atomic Energy Agency, Vienna (Austria). Section of Nutritional and Health-Related Environmental Studies. 1991. (CONF-8911338–: 2. research co-ordination meeting on the use of nuclear and nuclear-related techniques in the study of environmental pollution asociated with solid wastes, JAKARTA (Indonesia), 20 Nov 1989). In *Co-ordinated research programme on the use of nuclear and nuclear-related techniques in the study of environmental pollution associated with solid wastes: Report on the second research co-ordination meeting, Jakarta, Indonesia, 20-24 November 1989.* 233p. Order Number DE93606508. Source: OSTI; NTIS (US Sales Only); INIS.

Experimental facilities of internal beam PIXE, tube-excited ED-XRF, NAA, electrothermal AAS and DPASV have been established. The development of analytical procedures based on these principles is in progress for multielement trace analysis in different matrices including solid and liquid wastes. An intercomparison study of trace and minor element analysis in IAEA Soil and lake sediment standards was performed with source-excited ED-XRF method and good agreements were observed. Using the existing standard analytical techniques of source-excited ED-XRF and flame AAS, 34 effluent samples from paper, tannery and fertilizer industries were analyzed for about 15 elements with $Z > 19$ to obtain baseline information. Future studies will be directed to industrial emissions and effluents from fertilizer factories, paper mills, chemical industries, power plants and steel mills. (author). 5 refs, 6 figs, 3 tabs.

3701 (IAEA-NAHRES–6, pp. 4.1-4.13) **Study of the atmospheric aerosol composition in Zaire using nuclear and nuclear related techniques.** Maenhaut, W. (Ghent Rijksuniversiteit, Ghent (Belgium). Inst. voor Nucleaire Wetenschappen); Cornille, P.; Cafmeyer, J.; Lumu, B.M.; Tschiashala, M.D.; Matamba, K.; Akilimali, K.; Andreae, M.O. International Atomic Energy Agency, Vienna (Austria). Section of Nutritional and Health-Related Environmental Studies. 1991. (CONF-8911338–: 2. research co-ordination meeting on the use of nuclear and nuclear-related techniques in the study of environmental pollution asociated with solid wastes, JAKARTA (Indonesia), 20 Nov 1989). In *Co-ordinated research programme on the use of nuclear and nuclear-related techniques in the study of environmental pollution associated with solid wastes: Report on the second research co-ordination meeting, Jakarta, Indonesia, 20-24 November 1989.* 233p. Order Number DE93606508. Source: OSTI; NTIS (US Sales Only); INIS.

A small Nuclepore filter sampler collecting the total aerosol is being operated in Kinshasa, Zaire, since the beginning of 1985. Thus far, about 190 samples have been analyzed for black carbon (with a light reflection technique) and for up to 20 elements (by PIXE). The data set obtained was examined by absolute principal components analysis (APCA). This technique revealed the existence of 6 sources (components), i.e. soil dust, biomass burning, automotive emissions, a Cu-Zn source, a phosphate component and a mixed Mg/dust component. The extracted source profiles of the soil dust, biomass burning and automotive components compared well with those expected on the basis of literature data, at least for the important elements within each profile. The APCA further showed that the soil dust and the mixed Mg/dust components were responsible for most of the Mg, Al, Si, Ca, Ti, Mn, Fe and Sr. Black carbon, S, K and Rb originated mainly from biomass burning, and Pb and Br were almost exclusively attributed to the automotive emissions. (author). Refs, 7 tabs.

3702 (IAEA-NAHRES–6, pp. 5.1-5.7) **Application of neutron activation analysis to trace elements in environmental aerosols samples in Sao Paulo, Brazil.** Munita, C.S. (Instituto de Pesquisas Energeticas e Nucleares (IPEN), Sao Paulo, SP (Brazil). Radiochemistry Div.); Paiva, R.P.; Cunha, I.L. International Atomic Energy Agency, Vienna (Austria). Section of Nutritional and Health-Related Environmental Studies. 1991. (CONF-8911338–: 2. research co-ordination meeting on the use of nuclear and nuclear-related techniques in the study of environmental pollution asociated with solid wastes, JAKARTA (Indonesia), 20 Nov 1989). In *Co-ordinated research programme on the use of nuclear and nuclear-related techniques in the study of environmental pollution associated with solid wastes: Report on the second research co-ordination meeting, Jakarta, Indonesia, 20-24 November 1989.* 233p. Order Number DE93606508. Source: OSTI; NTIS (US Sales Only); INIS.

The purpose of this investigation is to obtain information about the atmospheric aerosols in the city of Sao Paulo and to perform, by means of the trace element results obtained by instrumental neutron activation analysis, a preliminary identification of the main sources of the atmospheric aerosols. 4 refs, 7 tabs.

3703 (IAEA-NAHRES–6, pp. 6.1-6.10) **Chemical factor patterns and leachability of incinerator and industrial stack solids.** Jervis, R.E. (Toronto Univ., ON (Canada). Dept. of Chemical Engineering and Applied Chemistry); Krishnan, S.S. International Atomic Energy Agency, Vienna (Austria). Section of Nutritional and Health-Related Environmental Studies. 1991. (CONF-8911338–: 2. research co-ordination meeting on the use of nuclear and nuclear-related techniques in the study of environmental pollution asociated with solid wastes, JAKARTA (Indonesia), 20 Nov 1989). In *Co-ordinated research programme on the use of nuclear and nuclear-related techniques in the study of environmental pollution associated with solid wastes: Report on the second research co-ordination meeting, Jakarta, Indonesia, 20-24 November 1989.* 233p. Order Number DE93606508. Source: OSTI; NTIS (US Sales Only); INIS.

The research being done under the IAEA Solid Wastes CRP is one part of a research program which is directed to study the environmental behaviour of selected inorganic components, their accumulation in the human body and environmental health assessment. Specimens selected for study include solid waste residues from industry, from municipal garbage, sewage and hospital incinerators nearby contaminated soil and surface deposits, water and sediments, atmospheric wet deposition, airborne particulate matter and emission stack fly ash, laboratory animal tissues, wild life specimens, and human scalp hair. The overall objectives include: (i) characterization of pollution sources through trace elements concentration patterns (or 'factors'), (ii) identification of toxic elements which are concentrated in solid wastes, aerosols or human tissues (iii) attempts to estimate pollution source contributions to the general environment, (iv) consideration of the bioavailability of selected elements of environmental health significance and (v) selection of suitable bioindicators of environmental pollution. (For the purpose of this solid wastes RCM only those experiments concerned with wastes and aerosols are presented). (author). 5 refs, 5 tabs.

3704 (IAEA-NAHRES–6, pp. 7.1-7.7) **Application of nuclear analysis techniques in the study of environmental pollution in the vicinity of Shanghai.** Li Minqian (Academia Sinica, Shanghai, SH (China). Shanghai Inst. of Nuclear Research). International Atomic Energy Agency, Vienna (Austria). Section of Nutritional and Health-Related Environmental Studies. 1991. (CONF-8911338–: 2. research co-ordination meeting on the use of nuclear and nuclear-related techniques in the study of environmental pollution asociated with solid wastes, JAKARTA (Indonesia), 20 Nov 1989). In *Co-ordinated research programme on the use of nuclear and nuclear-related techniques in the study of environmental pollution associated with solid wastes: Report on the second research co-ordination meeting, Jakarta, Indonesia, 20-24 November 1989.* 233p. Order Number DE93606508. Source: OSTI; NTIS (US Sales Only); INIS.

The initial aim of this project is to measure the elemental composition of aerosol samples from the northern part of Shanghai, the Shanghai Institute of Nuclear Research and a lead-zinc smeltery and its surroundings. As a next step the health impact of the pollution will be investigated by determining the concentrations of heavy metal pollutants in hair samples taken from smeltery workers and other inhabitants of the area. 2 refs, 1 fig., 2 tabs.

3705 (IAEA-NAHRES–6, pp. 8.1-8.12) **A study on trace elements concentration of atmospheric aerosol in Beijing city.** Wang Xinfu (Beijing Normal Univ., BJ (China). Inst. of Low Energy Nuclear Physics); Zhu Guanghua; Shen Xinyin. International Atomic Energy Agency, Vienna (Austria). Section of Nutritional and Health-Related Environmental Studies. 1991. (CONF-8911338–: 2.

research co-ordination meeting on the use of nuclear and nuclear-related techniques in the study of environmental pollution asociated with solid wastes, JAKARTA (Indonesia), 20 Nov 1989). In *Co-ordinated research programme on the use of nuclear and nuclear-related techniques in the study of environmental pollution associated with solid wastes: Report on the second research co-ordination meeting, Jakarta, Indonesia, 20-24 November 1989.* 233p. Order Number DE93606508. Source: OSTI; NTIS (US Sales Only); INIS.

315 air particulate samples were collected continuously in the vicinity of zinc smelter in summer and winter of 1988. 415 samples have been analyzed by PIXE technique (100 samples of them were collected before). The concentration calibration for the air particulate measurements is made with thin micromatter standards (Micromatter Corp). Integrated data processing were made including data of the coal-fired power station before. Average concentration of elements Zn, Pb, Cd, As and Cl in atmosphere of the vicinity of zinc-smelting crucible furnaces in three seasons are much higher then comparative site far from there. Average concentration of Pb is 1.7-22 times higher as permitted concentration in atmosphere of residential area. The potential toxic elements Zn, Pb, Cd, As, S, Br, Cl and Cr enriched mainly in fine mode particles. In addition, correlation coefficients between elemental concentration were calculated for air particulate samples from vicinity of coal-fired power station and source of elements were discussed. (author). 8 refs, 10 figs, 10 tabs.

3706 (IAEA-NAHRES–6, pp. 9.1-9.4) **Neutron activation studies of toxic elements in Czechoslovakian solid waste products.** Kucera, J. (Ustav Jaderneho Vyzkumu CSKAE, Rez (Czechoslovakia)); Obrusnik, I.; Faltejsek, J.; Soukal, L.; Spevackova, V. International Atomic Energy Agency, Vienna (Austria). Section of Nutritional and Health-Related Environmental Studies. 1991. (CONF-8911338–: 2. research co-ordination meeting on the use of nuclear and nuclear-related techniques in the study of environmental pollution asociated with solid wastes, JAKARTA (Indonesia), 20 Nov 1989). In *Co-ordinated research programme on the use of nuclear and nuclear-related techniques in the study of environmental pollution associated with solid wastes: Report on the second research co-ordination meeting, Jakarta, Indonesia, 20-24 November 1989.* 233p. Order Number DE93606508. Source: OSTI; NTIS (US Sales Only); INIS.

Research has been carried out in three areas. Instrumental neutron activation analysis (INAA) was used to test for 20-30 elements in a reference samples to check the accuracy of the method, and neutron activation analysis and atomic absorption spectroscopy were used to study the leachable forms of 10-20 elements in soils contaminated by sewage sludge from a metallurgical plant. Finally, INAA and scanning electron microscopy were used to study fly ash samples originating from brown coal or heavy oil combustion in large electric power and heating plants. 30-40 elements were determined in each type of fly ash sample. 5 refs, 1 tab.

3707 (IAEA-NAHRES–7) **Co-ordinated research programme on assessment of environmental exposure to mercury in selected human populations as studied by nuclear and other techniques: Report on the first research co-ordination meeting, Vienna, Austria, 10-13 June 1991.** International Atomic Energy Agency, Vienna (Austria). Section of Nutritional and Health-Related Environmental Studies. 1991. 105p. (CONF-9106411–: 1. research co-ordination meeting on assessment of environmental exposure to mercury in selected human populations as studied by nuclear and other techniques, Vienna (Austria), 10-13 Jun 1991). Order Number DE93606502. Source: OSTI; NTIS (US Sales Only); INIS.

A co-ordinated research programme on assessment of environmental exposure to mercury in selected human populations as studied by nuclear and other techniques has been initiated by the IAEA in collaboration with WHO. The purpose of this CRP is to promote national and regional studies to evaluate the exposure of selected population groups to mercury and methylmercury and to estimate potential health risks in these groups. The programme is focused on the analysis of human head hair for the determination of mercury and methylmercury. This CRP has two main components: (i) identifying population groups that are at risk, and (ii) studying health effects in the exposed persons, particularly pregnant women and the babies born to them. This document reports the discussion held during the first Research Co-ordination Meeting (RCM) for the CRP which took place at the IAEA Headquarters in Vienna.

3708 (IAEA-NAHRES–7, pp. 69-75) **Preparation of standard hair material and development of analytical methodology.** Gangadharan, S. (Bhabha Atomic Research Centre, Bombay (India). Analytical Chemistry Div.); Ganapathy Iyer, S.; Arunachalam, J.; Walvekar, A.P.; Remadevi, M. International Atomic Energy Agency, Vienna (Austria). Section of Nutritional and Health-Related Environmental Studies. 1991. (CONF-9106411–: 1. research co-ordination meeting on assessment of environmental exposure to mercury in selected human populations as studied by nuclear and other techniques, Vienna (Austria), 10-13 Jun 1991). In *Co-ordinated research programme on assessment of environmental exposure to mercury in selected human populations as studied by nuclear and other techniques: Report on the first research co-ordination meeting, Vienna, Austria, 10-13 June 1991.* 105p. Order Number DE93606502. Source: OSTI; NTIS (US Sales Only); INIS.

Atmospheric pollutants (aerosols, air particulates) have received due to attention but biomonitoring of exposure to the pollutants has only begun to receive the deserved attention. We had demonstrated in our earlier work about the role of human scalp hair as an effective monitor for exposure to inorganic (metallic) pollutants. Most of this work were at the initiation of a programme by the Agency in 1970s. Primary objectives and the scope of our plan of work will be preparation of "standard material" of hair with the help of the Agency and development and validation of analytical methodologies for total mercury and alkyl mercury; we anticipate problems in the characterization with respect to alkyl mercury from the point of standards and availability of suitable and adequate samples. 5 refs, 1 tab.

3709 (IAEA-NAHRES–7, pp. 23-30) **Determination of total mercury and methylmercury in human head hair by radiochemical methods of analysis.** Vasconcellos, M.B.A. (Brazilian Nuclear Energy Commission, Sao Paulo, SP (Brazil). Inst. for Nuclear and Energy Research); Saiki, M.; Paletti, G. International Atomic Energy Agency, Vienna (Austria). Section of Nutritional and Health-Related Environmental Studies. 1991. (CONF-9106411–: 1. research co-ordination meeting on assessment of environmental exposure to mercury in selected human populations as studied by nuclear and other techniques, Vienna (Austria), 10-13 Jun 1991). In *Co-ordinated research programme on assessment of environmental exposure to mercury in selected human populations as studied by nuclear and other techniques: Report on the first research co-ordination meeting, Vienna, Austria, 10-13 June 1991.* 105p. Order Number DE93606502. Source: OSTI; NTIS (US Sales Only); INIS.

Human hair samples have received lately much attention for studying trace elements in vivo. They can be used for monitoring environmental exposure to pollutants as well as for evaluating poisoning by heavy metals. Also the trace element composition of hair can be used for assessing nutritional status and can be related to human health or disease. Instrumental neutron activation analysis, due to its multi-elemental capabilities, has been applied by several authors to the trace analysis of many elements in hair. In the specific case of mercury and other elements like arsenic, selenium and antimony, also radiochemical separations have been developed. In Brazil hair samples were collected from two main groups up to now: Control group, of 30 people without any suspicion of contamination by mercury, e.g., university students and friends; Group of people living near the Billings Dam, in a small village called "Santa Cruz", of which 28 samples were collected up to now. The samples were collected according to the procedure recommended by the IAEA and analyzed by means of NAA. 12 refs.

3710 (IAEA-NAHRES–7, pp. 31-39) **Total mercury and methylmercury levels in pregnant women, nursing women and preschool children resident in fishing villages in the eighth region of Chile.** Bruhn, C.G. (Universidad de Concepcion, Concepcion (Chile). Dept. de Analisis Instrumental); Rodriguez, A.A.; Barrios, C.A.; Gras, N.T.; Becerra, J.; Nunez, E. International Atomic Energy Agency, Vienna (Austria). Section of Nutritional and Health-Related Environmental Studies. 1991. (CONF-9106411–: 1. research co-ordination meeting on assessment of environmental

exposure to mercury in selected human populations as studied by nuclear and other techniques, Vienna (Austria), 10-13 Jun 1991). In *Co-ordinated research programme on assessment of environmental exposure to mercury in selected human populations as studied by nuclear and other techniques: Report on the first research co-ordination meeting, Vienna, Austria, 10-13 June 1991.* 105p. Order Number DE93606502. Source: OSTI; NTIS (US Sales Only); INIS.

The main aim of this project is to perform a descriptive study about the levels of total mercury (Hg-T) and of methylmercury (Me-Hg) in human scalp hair specimens of a selected human population of high risk in the Eighth Region of Chile (composed by pregnant women, nurse women and prescholar children residing in fisheries distributed within the coastal zone of this region), whose diet should include fish and shellfish as main food components, and to evaluate the degree of mercury contamination of this population by comparison with a control population. 6 refs, 2 tabs.

3711 (IAEA-NAHRES–7, pp. 41-48) **Study on mercury level in scalp hair of typical human populations exposed to mercury in China by NAA and other techniques.** Chai Chifang (Academia Sinica, Beijing, BJ (China). Inst. of High Energy Physics); Qian Qinfang; Feng Weiyue. International Atomic Energy Agency, Vienna (Austria). Section of Nutritional and Health-Related Environmental Studies. 1991. (CONF-9106411–: 1. research co-ordination meeting on assessment of environmental exposure to mercury in selected human populations as studied by nuclear and other techniques, Vienna (Austria), 10-13 Jun 1991). In *Co-ordinated research programme on assessment of environmental exposure to mercury in selected human populations as studied by nuclear and other techniques: Report on the first research co-ordination meeting, Vienna, Austria, 10-13 June 1991.* 105p. Order Number DE93606502. Source: OSTI; NTIS (US Sales Only); INIS.

Based on the IAEA Co-ordinated Research Programme in Environmental Exposure to Mercury in Selected Human Populations and the specific Hg pollution background in China, we intend to establish NAA and mercurymeter (a variety of AAS for Hg analysis) for determining total Hg at ppm to ppb levels. The emphasis in total Hg analytical methodology lies in examination of volatile loss of Hg in various experimental conditions during sample preparation, irradiation in nuclear reactor and other treatments. Establish GC(EC) for Me-Hg analysis. We intend to use the enrichment of Me-Hg on a specially-prepared sulphydryl cotton column. The preparatory experiments have been carried out, including acidity, elution and benzene-extraction, etc. Synchrotronous X-ray microscanning analysis for study of longitudinal distribution of Hg along scalp hair sample. Collect typical human hair samples in Hg-polluted and normal controlled districts. The 9 cm or longer head hair strands will be taken, especially from the pregnant women and the babies born to them. Also, some blood samples will be collected, if possible. 4 figs, 2 tabs.

3712 (IAEA-NAHRES–7, pp. 77-81) **Mercury levels in defined Italian population groups.** Ingrao, G. (ENEA, Casaccia (Italy). Centro Ricerche Energia); Belloni, P.; Santaroni, G.P. International Atomic Energy Agency, Vienna (Austria). Section of Nutritional and Health-Related Environmental Studies. 1991. (CONF-9106411–: 1. research co-ordination meeting on assessment of environmental exposure to mercury in selected human populations as studied by nuclear and other techniques, Vienna (Austria), 10-13 Jun 1991). In *Co-ordinated research programme on assessment of environmental exposure to mercury in selected human populations as studied by nuclear and other techniques: Report on the first research co-ordination meeting, Vienna, Austria, 10-13 June 1991.* 105p. Order Number DE93606502. Source: OSTI; NTIS (US Sales Only); INIS.

Our group conducts its research activity in the Department AMBBIO (Biological and Sanitary Effect of Toxic Agents) of ENEA (National Committee for Research and Development of Nuclear and Alternative Energy) at the research centre of Casaccia. The food chain is the main pathway leading to humans for most of the trace elements. The research, therefore, has been directed mainly towards the study of the variability of the trace element content in the Italian diet. This programme aims at assessing the adequacy of the essential trace elements ingestion, and to verify that the ingestion of toxic trace elements is below the recommended values. Part of this research was conducted in the frame of the IAEA CRP on "Human daily Intakes of Nutritionally Important Trace Elements as Measured by Nuclear and Other Techniques". Studies carried out by the National Institute of Nutrition and FAO have shown that there are some population groups having a fish consumption significantly higher than the average value for the Italian population. These groups are usually found in coastal towns were fishing is one of the main occupation and generally includes fishermen, fish dealers, restaurant workers and their families. A pilot study was conducted in one of these towns, Bagnara Calabra in the South of Italy, where the average fish consumption is 27.1 kg per year, which is more than twice the national average. The results have shown that the mercury concentration in the diet is significantly higher than in other Italian locations, the mercury levels in blood and hair sample in these subjects are also significantly higher than the values reported for subjects of the general Italian population. 6 refs.

3713 (IAEA-NAHRES–7, pp. 83-91) **Intake of mercury through fish consumption.** Sarmani, S. (Universiti Kebangsaan Malaysia, Bangi (Malaysia). Dept. of Nuclear Science); Majid, A.A.; Wood, A.K.; Hamzah, Z. International Atomic Energy Agency, Vienna (Austria). Section of Nutritional and Health-Related Environmental Studies. 1991. (CONF-9106411–: 1. research co-ordination meeting on assessment of environmental exposure to mercury in selected human populations as studied by nuclear and other techniques, Vienna (Austria), 10-13 Jun 1991). In *Co-ordinated research programme on assessment of environmental exposure to mercury in selected human populations as studied by nuclear and other techniques: Report on the first research co-ordination meeting, Vienna, Austria, 10-13 June 1991.* 105p. Order Number DE93606502. Source: OSTI; NTIS (US Sales Only); INIS.

Under the coordinated research programme we plan to carry out a systematic study on the intake of mercury through fish consumption. This will be the first of such a project to be carried out in Malaysia. The objectives are to carry out a systematic study on the analysis of mercury in head hair samples from population groups in selected fishing villages located within industrial zones, and a survey on the daily intake of fish and fishery products by the population group, to carry out a systematic study on the analysis of mercury in fish and fishery products samples available to and consumed by the population group and analyze mercury in riverine, estuarine and marine sediments in the vicinity of the selected fishing villages. 2 tabs, 1 map.

3714 (IAEA-NAHRES–7, pp. 93-99) **Analytical quality control in studies of environmental exposure to mercury.** Horvat, M. (Institute Josef Stefan, Ljubljana (Yugoslavia). Nuclear Chemistry Dept.). International Atomic Energy Agency, Vienna (Austria). Section of Nutritional and Health-Related Environmental Studies. 1991. (CONF-9106411–: 1. research co-ordination meeting on assessment of environmental exposure to mercury in selected human populations as studied by nuclear and other techniques, Vienna (Austria), 10-13 Jun 1991). In *Co-ordinated research programme on assessment of environmental exposure to mercury in selected human populations as studied by nuclear and other techniques: Report on the first research co-ordination meeting, Vienna, Austria, 10-13 June 1991.* 105p. Order Number DE93606502. Source: OSTI; NTIS (US Sales Only); INIS.

The importance of studies of exposure of human population to mercury through excessive seafood consumption is well known. A considerable amount of work has been done on such studies. However, the intakes of methyl mercury associated with threshold effects on human health, and particularly with regard to foetal effects, remain largely undefined. Our objective is to participate in the new CRP as a reference and quality assurance laboratory, with the possibility of running formal/informal training courses for other participants in total and methyl mercury analysis and Se determination. We would like to participate in a multidisciplinary study involving one or more of the other participating groups, connected with a population definitely at risk from excessive sea food consumption, with emphasis on health effects, particularly on the foetus. 27 refs.

3715 (IAEA-NAHRES–7, pp. 59-67) **The effect of methylmercury on small animals and the use of their hair as a reference material for Hg and methylmercury analytical quality control.** Bacso, J. (Magyar Tudomanyos Akademia, Debrecen

(Hungary). Atommag Kutato Intezete); Uzonyi, I.; Bacso, Z.; Fekete, I.; Ferenczy, T. International Atomic Energy Agency, Vienna (Austria). Section of Nutritional and Health-Related Environmental Studies. 1991. (CONF-9106411–: 1. research co-ordination meeting on assessment of environmental exposure to mercury in selected human populations as studied by nuclear and other techniques, Vienna (Austria), 10-13 Jun 1991). In *Co-ordinated research programme on assessment of environmental exposure to mercury in selected human populations as studied by nuclear and other techniques: Report on the first research co-ordination meeting, Vienna, Austria, 10-13 June 1991.* 105p. Order Number DE93606502. Source: OSTI; NTIS (US Sales Only); INIS.

Mercury is circulated naturally in the biosphere. 30,000-150,000 tons being released into the atmosphere by degassing from the earth's crust and the oceans and additional 20000 tons of mercury are released into the environment each year by human activities, such as combustion of fossil fuels and other industrial release. The Hg content in hair and blood was used for determination of amount of Hg intake. Correlation was found between the Hg content in hair and blood and the daily consumption average amount of fish. The investigation of Hg content along the hair string makes it possible to determine the peak time of Hg intake. Animal experiments and accidental human cases show that the Hg content in hair can served as indicator of exposure to Hg. It is surprising that in spite of many cases with sporadic character and epidemic measure took place, there is not hair standard for Hg by this time. This arises the demand at the IAEA to have hair standard with known Hg content. In this paper we outline our plan for getting suitable hair standard with different Hg content 18 refs, 1 fig., 4 tabs.

3716 (IAEA-NAHRES–9) **Co-ordinated research programme on the use of nuclear and nuclear-related techniques in the study of environmental pollution associated with solid wastes: Report on the third research co-ordination meeting, Vienna, Austria, 10-13 September 1991.** International Atomic Energy Agency, Vienna (Austria). Section of Nutritional and Health-Related Environmental Studies. 1992. 381p. (CONF-9109445–: 3. research co-ordination meeting on the use of nuclear and nuclear-related techniques in the study of environmental pollution associated with solid wastes, Vienna (Austria), 10-13 Sep 1991). Order Number DE93606509. Source: OSTI; NTIS (US Sales Only); INIS.

A co-ordinated research programme on the use of nuclear and nuclear-related techniques in the study of environmental pollution associated with solid wastes was started by the IAEA in December 1987 and now comprises nineteen participants from seventeen countries. Topics of interest in this programme include studies of atmospheric aerosols, coal fly ash, incinerator ash, sewage sludge and a variety of other environmental specimens contaminated with solid wastes. The analytical techniques used include neutron activation analysis, particle-induced X-ray emission and energy-dispersive X-ray fluorescence. This report summarizes the discussions that took place during the third research co-ordination meeting. Working papers presented by the participants are included as annexes and have been indexed separately. Refs, figs and tabs.

3717 (IAEA-NAHRES–9, pp. 15-30) **Monitoring of heavy metal pollutants in air particulates in Bangladesh.** Khaliquzzaman, M. (Atomic Energy Centre, Dacca (Bangladesh)); Biswas, S.K. International Atomic Energy Agency, Vienna (Austria). Section of Nutritional and Health-Related Environmental Studies. 1992. (CONF-9109445–: 3. research co-ordination meeting on the use of nuclear and nuclear-related techniques in the study of environmental pollution associated with solid wastes, Vienna (Austria), 10-13 Sep 1991). In *Co-ordinated research programme on the use of nuclear and nuclear-related techniques in the study of environmental pollution associated with solid wastes: Report on the third research co-ordination meeting, Vienna, Austria, 10-13 September 1991.* 381p. Order Number DE93606509. Source: OSTI; NTIS (US Sales Only); INIS.

Methods have been implemented to analyse integral air particulate samples using EDXFR and PIXE techniques. These methods have been used to analyse some quality control samples of air particulates and a fly ash sample. Some field samples of air particulates collected in Bangladesh have also been analysed. (author). 12 refs, 6 figs, 7 tabs.

3718 (IAEA-NAHRES–9, pp. 31-47) **Study of coal combustion aerosols using size fractionating sampling and nuclear analytical techniques.** Maenhaut, W. (Gent Rijksuniversiteit, Gent (Belgium). Inst. voor Nucleaire Wetenschappen); Baecke, V.; Gilot, C.; Cafmeyer, J.; Kauppinen, E.I.; Lind, T.M. International Atomic Energy Agency, Vienna (Austria). Section of Nutritional and Health-Related Environmental Studies. 1992. (CONF-9109445–: 3. research co-ordination meeting on the use of nuclear and nuclear-related techniques in the study of environmental pollution associated with solid wastes, Vienna (Austria), 10-13 Sep 1991). In *Co-ordinated research programme on the use of nuclear and nuclear-related techniques in the study of environmental pollution associated with solid wastes: Report on the third research co-ordination meeting, Vienna, Austria, 10-13 September 1991.* 381p. Order Number DE93606509. Source: OSTI; NTIS (US Sales Only); INIS.

The chemical composition of aerosols emitted during coal combustion was studied as a function of particle size down to sizes down of 0.01 μm. The aerosol collections were carried out in a circulating fluidized bed coal boiler, upstream of the electrostatic precipitator. The sampling device consisted of a cyclone and Berner low-pressure impactor, placed in a series. The samples were analyzed by instrumental neutron activation analysis for up to about 40 elements. The elemental concentrations in the particulate matter for each impaction stage were plotted as a function of stage number (particle size). For the elements Na, Al, K, Ca, Sc, Ti, V, Ga, La and Sm, the concentration variation was limited to a factor of 2 to 4 and the concentrations of these elements were lower for the initial and final impactor stages than for the intermediate particle sizes. The concentration variations were also limited to a factor of 2-4 for the elements Mn, Fe, As, Sb and Th, but all these elements showed increasing concentrations with decreasing particle size. Still other elements, such as Ni, Cr, Co, Zn, W, Mo and the halogens were highly enriched (up to 20-100 fold) in the fine particles when compared to the coarse particles. (author). 14 refs, 6 figs, 2 tabs.

3719 (IAEA-NAHRES–9, pp. 49-62) **Application of neutron activation analysis to trace element in environmental aerosol samples in Sao Paulo - Brazil.** Munita, C.S. (Instituto de Pesquisas Energeticas e Nucleares (IPEN), Sao Paulo, SP (Brazil). Radiochemistry Div.); Paiva, R.P.; Cunha, I.I.L. International Atomic Energy Agency, Vienna (Austria). Section of Nutritional and Health-Related Environmental Studies. 1992. (CONF-9109445–: 3. research co-ordination meeting on the use of nuclear and nuclear-related techniques in the study of environmental pollution associated with solid wastes, Vienna (Austria), 10-13 Sep 1991). In *Co-ordinated research programme on the use of nuclear and nuclear-related techniques in the study of environmental pollution associated with solid wastes: Report on the third research co-ordination meeting, Vienna, Austria, 10-13 September 1991.* 381p. Order Number DE93606509. Source: OSTI; NTIS (US Sales Only); INIS.

Fine and coarse particles in suspension in the atmosphere were collected on two teflon filters using a dichotomous sampler. The concentration of Al, Br, Ca, Ce, Cl, Co, Cr, Fe, K, La, Mn, Na, P, Pb, S, Sb, Sc, Se, Si, Sm, Th, V, and Zn was determined by ED-XRF and INAA. The elemental concentration was analyzed using linear correlation coefficients, enrichment factors and principal factor analysis, in order to identify the aerosol sources. The main sources of the aerosol particles were the marine one, re-suspended soil, fuel oil combustion, phosphatic rocks, refuse incineration and residual high temperature processes. (author). 15 refs, 7 tabs.

3720 (IAEA-NAHRES–9, pp. 63-73) **Environmental pollution from solid wastes.** Jervis, R.E. (Toronto Univ., ON (Canada). Dept. of Chemical Engineering and Applied Chemistry); Krishnan, S.S.; Accetone, P.; Arifin, N.; Ko, M.M.C.; Nhan, C.; Nguyen, L.; Vela, L.; Yee, T. International Atomic Energy Agency, Vienna (Austria). Section of Nutritional and Health-Related Environmental Studies. 1992. (CONF-9109445–: 3. research co-ordination meeting on the use of nuclear and nuclear-related techniques in the study of environmental pollution associated with solid wastes,

Vienna (Austria), 10-13 Sep 1991). In *Co-ordinated research programme on the use of nuclear and nuclear-related techniques in the study of environmental pollution associated with solid wastes: Report on the third research co-ordination meeting, Vienna, Austria, 10-13 September 1991.* 381p. Order Number DE93606509. Source: OSTI; NTIS (US Sales Only); INIS.

Research completed under the CRP during the past two years has encompassed several related aspects of environmental problems associated with solid wastes: assessment of major sources of toxic elements in a variety of solid waste forms, their leachability by simulated groundwater or rain/acid rain and the determination of the contribution of hospital incinerator to atmospheric releases. The summary of the findings of these investigations are given in this report. Unexpected high levels of cadmium have been found in many solid wastes. Leaching tests indicate that, in some cases, over 70% of this can be leached out into the nearby waterways. Combustibility tests indicated that 35 to 45% of it is emitted to the atmosphere during burning. This explains the increased levels of cadmium in air particulates sampled downwind from waste incinerators. Plastic items in municipal and hospital wastes were particularly elevated in Cd, Cl, Cr, Ba and Zn. Up to 1300 μg/g of Cd was found in some domestic items. By inference, Pb also is found in some common plastics but the current studies did not permit Pb determination in solid wastes, but only in aerosols. (author). 8 tabs.

3721 (IAEA-NAHRES–9, pp. 75-84) **Application of nuclear analysis techniques in the study of environmental pollution in the vicinity of Shanghai.** Li Minqian (Academia Sinica, Shanghai, SH (China). Shanghai Inst. of Nuclear Research). International Atomic Energy Agency, Vienna (Austria). Section of Nutritional and Health-Related Environmental Studies. 1992. (CONF-9109445–: 3. research co-ordination meeting on the use of nuclear and nuclear-related techniques in the study of environmental pollution associated with solid wastes, Vienna (Austria), 10-13 Sep 1991). In *Co-ordinated research programme on the use of nuclear and nuclear-related techniques in the study of environmental pollution associated with solid wastes: Report on the third research co-ordination meeting, Vienna, Austria, 10-13 September 1991.* 381p. Order Number DE93606509. Source: OSTI; NTIS (US Sales Only); INIS.

Aerosol samples have been collected from the Shanghai area and subjected to PIXE analysis. The results show that there is a serious level of air pollution around the Guichi lead-zinc smeltery. In addition, X-ray fluorescence analysis of hair samples from smeltery workers shows that the samples contain significantly higher (3-fold) lead concentrations than do samples from unexposed workers. 5 refs, 3 figs, 4 tabs.

3722 (IAEA-NAHRES–9, pp. 85-101) **Study of the atmospheric aerosol composition and some characteristics by PIXE technique.** Wang Xingfu (Beijing Normal Univ., BJ (China). Inst. of Low Energy Nuclear Physics); Zhu Guanghua; Shen Xinyin. International Atomic Energy Agency, Vienna (Austria). Section of Nutritional and Health-Related Environmental Studies. 1992. (CONF-9109445–: 3. research co-ordination meeting on the use of nuclear and nuclear-related techniques in the study of environmental pollution associated with solid wastes, Vienna (Austria), 10-13 Sep 1991). In *Co-ordinated research programme on the use of nuclear and nuclear-related techniques in the study of environmental pollution associated with solid wastes: Report on the third research co-ordination meeting, Vienna, Austria, 10-13 September 1991.* 381p. Order Number DE93606509. Source: OSTI; NTIS (US Sales Only); INIS.

The atmospheric concentrations of Al, Si, S, Cl, K, Ca, Ti, V, Cr, Mn, Fe, Ni, Cu, Zn, Pb, Br, Se, As, Mg and Co in the vicinity of the coal-fired power station of Beijing and of two modern zinc-smelting plants in another province were determined by PIXE analysis, and their variations with time were followed. In addition, PIXE investigations of aerosols from three typical Beijing districts are reported. 5 refs, 10 figs, 9 tabs.

3723 (IAEA-NAHRES–9, pp. 103-128) **Neutron activation studies of toxic elements in Czechoslovakian solid waste products.** Kucera, J. (Ustav Jaderneho Vyzkumu CSKAE, Rez (Czechoslovakia)); Faltejsek, J.; Kocman, C.; Obrusnik, I.; Spevackova, V. International Atomic Energy Agency, Vienna (Austria). Section of Nutritional and Health-Related Environmental Studies. 1992. (CONF-9109445–: 3. research co-ordination meeting on the use of nuclear and nuclear-related techniques in the study of environmental pollution associated with solid wastes, Vienna (Austria), 10-13 Sep 1991). In *Co-ordinated research programme on the use of nuclear and nuclear-related techniques in the study of environmental pollution associated with solid wastes: Report on the third research co-ordination meeting, Vienna, Austria, 10-13 September 1991.* 381p. Order Number DE93606509. Source: OSTI; NTIS (US Sales Only); INIS.

This paper reports three uses of neutron activation analysis: to study the composition of aerosols in a low- and a high-pollution area of Bohemia; to determine the composition of fly ash samples collected from several coal-fired power plants and local heating plants; and to study element leaching from fly ash. 4 refs, 11 figs, 15 tabs.

3724 (IAEA-NAHRES–9, pp. 129-134) **Assessment of heavy metal pollution in Ghana by nuclear-related techniques.** Akoto Bamford, S. (National Nuclear Research Inst., Kwabenya (Ghana). Physics Dept.); Aboh, I.; Osae, E.; Biney, C.; Antiwi, L. International Atomic Energy Agency, Vienna (Austria). Section of Nutritional and Health-Related Environmental Studies. 1992. (CONF-9109445–: 3. research co-ordination meeting on the use of nuclear and nuclear-related techniques in the study of environmental pollution associated with solid wastes, Vienna (Austria), 10-13 Sep 1991). In *Co-ordinated research programme on the use of nuclear and nuclear-related techniques in the study of environmental pollution associated with solid wastes: Report on the third research co-ordination meeting, Vienna, Austria, 10-13 September 1991.* 381p. Order Number DE93606509. Source: OSTI; NTIS (US Sales Only); INIS.

X-ray fluorescence analysis and atomic absorption spectrophotometry was used to test for the presence and levels of heavy metals in solid wastes discharged from the gold mining industry. This report contains the results of the analysis of vegetation and river sediment samples. 2 refs, 2 tabs.

3725 (IAEA-NAHRES–9, pp. 135-152) **Determination of heavy metal distribution in the environment of Thessaloniki, Greece by means of nuclear microanalysis.** Kouimtzis, T. (Thessaloniki, Univ., Thessaloniki (Greece). Dept. of Chemistry); Misaelides, P.; Samara, C.; Annousis, I.; Tsalev, D. International Atomic Energy Agency, Vienna (Austria). Section of Nutritional and Health-Related Environmental Studies. 1992. (CONF-9109445–: 3. research co-ordination meeting on the use of nuclear and nuclear-related techniques in the study of environmental pollution associated with solid wastes, Vienna (Austria), 10-13 Sep 1991). In *Co-ordinated research programme on the use of nuclear and nuclear-related techniques in the study of environmental pollution associated with solid wastes: Report on the third research co-ordination meeting, Vienna, Austria, 10-13 September 1991.* 381p. Order Number DE93606509. Source: OSTI; NTIS (US Sales Only); INIS.

The toxic element contents of seven species of vegetables (cabbage, carrot, celery, endive, leek, lettuce and spinach) from the Thessaloniki area were determined by neutron activation analysis or atomic absorption spectroscopy. Large variations of element concentrations were observed both between vegetable species and between sample sites. 10 refs, 6 figs, 2 tabs.

3726 (IAEA-NAHRES–9, pp. 153-177) **Leaching behaviour of toxic elements in hungarian fly-ash.** Rausch, H. (KFKI Institute of Atomic Energy Research of the Hungarian Academy of Sciences, Budapest (Hungary)); Sziklai Laszlo, I.; Baranyai Fliszar, R. International Atomic Energy Agency, Vienna (Austria). Section of Nutritional and Health-Related Environmental Studies. 1992. (CONF-9109445–: 3. research co-ordination meeting on the use of nuclear and nuclear-related techniques in the study of environmental pollution associated with solid wastes, Vienna (Austria), 10-13 Sep 1991). In *Co-ordinated research programme on the use of nuclear and nuclear-related techniques in the study of environmental pollution associated with solid wastes: Report on the third research co-ordination meeting, Vienna, Austria, 10-13 September 1991.* 381p. Order Number DE93606509. Source: OSTI; NTIS (US Sales Only); INIS.

This paper reports a study of the leachability of four Hungarian fly-ash particulate matters by means of instrumental neutron activation analysis, inductive coupled plasma atomic emission spectroscopy and ion-chromatographic multielement techniques. The leachabilities of thirty elements and/or their detection limits were investigated. 5 refs, 5 figs, 11 tabs.

3727 (IAEA-NAHRES–9, pp. 179-195) **Environmental impact assessment of coal fired thermal power stations.** Nambi, K.S.V. (Bhabha Atomic Research Centre, Trombay, Bombay (India). Environmental Assessment Div.); Sadasivan, S.; Negi, B.S.; Meenakshy, V. International Atomic Energy Agency, Vienna (Austria). Section of Nutritional and Health-Related Environmental Studies. 1992. (CONF-9109445–: 3. research co-ordination meeting on the use of nuclear and nuclear-related techniques in the study of environmental pollution associated with solid wastes, Vienna (Austria), 10-13 Sep 1991). In *Co-ordinated research programme on the use of nuclear and nuclear-related techniques in the study of environmental pollution associated with solid wastes: Report on the third research co-ordination meeting, Vienna, Austria, 10-13 September 1991.* 381p. Order Number DE93606509. Source: OSTI; NTIS (US Sales Only); INIS.

Coal fly ash samples collected from various thermal power plants and one lignite ash sample were analysed for various elements such as As, Ca, Ce, Co, Cr, Cu, Eu, Fe, Hf, K, La, Lu, Mn, Na, Ni, Pb, Rb, Se, Si, Sb, Sc, Sm, Sr, Ti, V, Yb and Zn using energy dispersive X-ray fluorescence and instrumental neutron activation analysis methods. The two-step maximum leachability test was also performed on all fly ash samples. 13 refs, 9 tabs.

3728 (IAEA-NAHRES–9, pp. 197-217) **The use of neutron activation analysis for the study of environmental risks associated with the fly ash from burning Polish coals.** Dybczynski, R. (Institute of Nuclear Chemistry and Technology, Warsaw (Poland). Dept. of Analytical Chemistry); Kulisa, K.; Malusecka, M.; Polkowska Motrenko, H.; Samczynski, Z.; Szopa, Z.; Tenerowicz, B. International Atomic Energy Agency, Vienna (Austria). Section of Nutritional and Health-Related Environmental Studies. 1992. (CONF-9109445–: 3. research co-ordination meeting on the use of nuclear and nuclear-related techniques in the study of environmental pollution associated with solid wastes, Vienna (Austria), 10-13 Sep 1991). In *Co-ordinated research programme on the use of nuclear and nuclear-related techniques in the study of environmental pollution associated with solid wastes: Report on the third research co-ordination meeting, Vienna, Austria, 10-13 September 1991.* 381p. Order Number DE93606509. Source: OSTI; NTIS (US Sales Only); INIS.

This report presents leaching experiments with irradiated fly ash from the Kozienice Power Station and, as a reference, with a Czechoslovakian fly ash sample. 7 refs, 11 figs, 3 tabs.

3729 (IAEA-NAHRES–9, pp. 219-241) **Determination of atmospheric trace elements by INAA: An application of receptor modelling.** Tuncel, G. (Middle East Technical Univ., Ankara (Turkey). Dept. of Environmental Engineering); Aras, N.K.; Yatin, M. International Atomic Energy Agency, Vienna (Austria). Section of Nutritional and Health-Related Environmental Studies. 1992. (CONF-9109445–: 3. research co-ordination meeting on the use of nuclear and nuclear-related techniques in the study of environmental pollution associated with solid wastes, Vienna (Austria), 10-13 Sep 1991). In *Co-ordinated research programme on the use of nuclear and nuclear-related techniques in the study of environmental pollution associated with solid wastes: Report on the third research co-ordination meeting, Vienna, Austria, 10-13 September 1991.* 381p. Order Number DE93606509. Source: OSTI; NTIS (US Sales Only); INIS.

The concentrations of twenty-eight elements in samples of airborne particulates from Ankara or a nearby area were determined by neutron activation analysis. It is hoped to use the data to provide information on the sources of the pollution in the city and to test emission inventory and dispersion models that will be developed in the course of the study. 14 refs, 6 tabs, figs.

3730 (IAEA-NAHRES–9, pp. 243-285) **Development of a particulate filter standard and its use in an IAEA interlaboratory evaluation.** Vermette, S.J. (Illinois States Water Survey, Champaign, IL (United States). Atmospheric Sciences Div.); Williams, A.L.; Landsberger, S.; Verinette, V.G. International Atomic Energy Agency, Vienna (Austria). Section of Nutritional and Health-Related Environmental Studies. 1992. (CONF-9109445–: 3. research co-ordination meeting on the use of nuclear and nuclear-related techniques in the study of environmental pollution associated with solid wastes, Vienna (Austria), 10-13 Sep 1991). In *Co-ordinated research programme on the use of nuclear and nuclear-related techniques in the study of environmental pollution associated with solid wastes: Report on the third research co-ordination meeting, Vienna, Austria, 10-13 September 1991.* 381p. Order Number DE93606509. Source: OSTI; NTIS (US Sales Only); INIS.

A set of filter standards were prepared by suspending NIES Vehicle Exhaust Particulate onto Teflon filters. To improve the adhesion of particles, a thin layer of mineral oil was applied as an aerosol to the deposit side of the filters. The suspension apparatus was designed to ensure sample homogeneity (particle size and deposit) and elemental analysis provided an information value which confirmed elemental homogeneity between filters. Participating laboratories were sent a set of two filter standards, one fine and one coarse loaded, and two filter blanks. Performance was evaluated by comparison with the information values and on how one laboratory compared with another. Overall, the participating laboratories showed agreement within expected errors, with the exception of a few elements for each of the laboratories. Evaluation rankings ranged form excellent to poor. (author). 7 refs, 5 figs, 7 tabs.

3731 (IAEA-NAHRES–9, pp. 287-299) **Atmosphere trace elements in gaseous and small size particles forms.** Kist, An.A. (Institute of Nuclear Physics, Tashkent (Russian Federation)); Kist, A.A.; Zhuk, L.I. International Atomic Energy Agency, Vienna (Austria). Section of Nutritional and Health-Related Environmental Studies. 1992. (CONF-9109445–: 3. research co-ordination meeting on the use of nuclear and nuclear-related techniques in the study of environmental pollution associated with solid wastes, Vienna (Austria), 10-13 Sep 1991). In *Co-ordinated research programme on the use of nuclear and nuclear-related techniques in the study of environmental pollution associated with solid wastes: Report on the third research co-ordination meeting, Vienna, Austria, 10-13 September 1991.* 381p. Order Number DE93606509. Source: OSTI; NTIS (US Sales Only); INIS.

Data are presented that show the dependence of the composition of aerosol samples upon the filters used for sampling and on sample treatment and storage conditions. The dependence is the most appreciable for volatile elements. The data show that a number of advantages are associated with investigating atmospheric composition by sampling vapour-gas and submicron aerosol phases. 8 refs, 5 figs, 4 tabs.

3732 (IAEA-NAHRES–9, pp. 301-315) **A study of the impact of Sostanj coal fired thermal power plant on aerosols using INAA.** Stropnik, B. (Institut Jozef Stefan, Ljubljana (Yugoslavia)); Smodis, B.; Jacimovic, R.; Stegnar, P. International Atomic Energy Agency, Vienna (Austria). Section of Nutritional and Health-Related Environmental Studies. 1992. (CONF-9109445–: 3. research co-ordination meeting on the use of nuclear and nuclear-related techniques in the study of environmental pollution associated with solid wastes, Vienna (Austria), 10-13 Sep 1991). In *Co-ordinated research programme on the use of nuclear and nuclear-related techniques in the study of environmental pollution associated with solid wastes: Report on the third research co-ordination meeting, Vienna, Austria, 10-13 September 1991.* 381p. Order Number DE93606509. Source: OSTI; NTIS (US Sales Only); INIS.

Air pollution in the Salek Valley, Slovenia, is critical, mostly due to the Sostanj Thermal Power Plant (TPP). Therefore, airborne particulate as monitors of air pollution and their impact on the environment were studied Analysis was made by instrumental neutron activation analysis (INAA) using the TRIGA Mark II reactor of the Jozef Stefan Institute, Ljubljana. Preliminary analytical results of elemental concentrations in the total aerosol fraction during summer when lowering emissions are expected, showed relatively high chromium concentrations in the town of Sostanj. On the basis of these results a more detailed project, covering 9 sampling reference sites near Sostanj TPP and 1 sampling site at a reference

location was planned. 5 sites at the same locations as on-line operated power plant ecological systems equipped with Monitor Labs equipment devices for monitoring gaseous pollutants, and 4 other sampling sites are near the ash disposal. At each sampling site, a separator of in-house construction, separating aerosols into two main fractions, inhalable and respirable, is operated. The project started in summer 1991, and the first results are discussed. (author). 8 refs, 3 figs, 6 pictures.

3733 (IAEA-NAHRES–9, pp. 317-326) **Applications of x-ray emission spectroscopy in evaluating the environmental impact of coal burning power plant.** Jaksic, M. (Ruder Boskovic Inst., Zagreb, Croatia (Yugoslavia). Lab. for Nuclear Microanalysis); Fazinic, S.; Valkovic, V. International Atomic Energy Agency, Vienna (Austria). Section of Nutritional and Health-Related Environmental Studies. 1992. (CONF-9109445–: 3. research co-ordination meeting on the use of nuclear and nuclear-related techniques in the study of environmental pollution associated with solid wastes, Vienna (Austria), 10-13 Sep 1991). In *Co-ordinated research programme on the use of nuclear and nuclear-related techniques in the study of environmental pollution associated with solid wastes: Report on the third research co-ordination meeting, Vienna, Austria, 10-13 September 1991.* 381p. Order Number DE93606509. Source: OSTI; NTIS (US Sales Only); INIS.

The environmental impact study of the coal burning power plant Plomin I is finalized by the monitoring of radiological impact. Because of the recent closure of all Istrian basin coal mines, more research is made on coals and fly ashes form other sources. A special attention is given on the analysis of individual particles of fly ash by proton microbeam, in order to study toxic elements distribution and their correlation to matrix composition and morphological characteristics. Development of analytical methods is also discussed since the new proton microprobe facility in Zagreb started operation recently. (author). 3 refs, 6 figs.

3734 (IAEA-NAHRES–9, pp. 327-349) **The application of nuclear and nuclear-related techniques for environmental pollution studies in Vietnam.** Nguyen Mong Sinh (Nuclear Research Inst., Dalat (Viet Nam)). International Atomic Energy Agency, Vienna (Austria). Section of Nutritional and Health-Related Environmental Studies. 1992. (CONF-9109445–: 3. research co-ordination meeting on the use of nuclear and nuclear-related techniques in the study of environmental pollution associated with solid wastes, Vienna (Austria), 10-13 Sep 1991). In *Co-ordinated research programme on the use of nuclear and nuclear-related techniques in the study of environmental pollution associated with solid wastes: Report on the third research co-ordination meeting, Vienna, Austria, 10-13 September 1991.* 381p. Order Number DE93606509. Source: OSTI; NTIS (US Sales Only); INIS.

The applicability of neutron activation analysis, X-ray fluorescence and other related techniques to environmental samples from Viet Nam has been investigated. Results show that multielemental analysis of environmental samples and the determination of heavy metal pollution in the environment is best performed by a combination of techniques. Preliminary results of studying the environmental pollution associated with solid wastes are reported. 4 refs, 5 figs, 17 tabs.

3735 (IAEA-NAHRES–9, pp. 351-362) **Study of atmospheric aerosols in Zaire by instrumental neutron activation analysis, atomic absorption spectrophotometry and ion-exchange chromatography.** Tshiashala, M.D. (Centre Regional d'Etudes Nucleaires de Kinshasa, (CREN-K) (Zaire)); Lumu, B.M.; Matamba, K.; Ronneau, C. International Atomic Energy Agency, Vienna (Austria). Section of Nutritional and Health-Related Environmental Studies. 1992. (CONF-9109445–: 3. research co-ordination meeting on the use of nuclear and nuclear-related techniques in the study of environmental pollution associated with solid wastes, Vienna (Austria), 10-13 Sep 1991). In *Co-ordinated research programme on the use of nuclear and nuclear-related techniques in the study of environmental pollution associated with solid wastes: Report on the third research co-ordination meeting, Vienna, Austria, 10-13 September 1991.* 381p. Order Number DE93606509. Source: OSTI; NTIS (US Sales Only); INIS.

Instrumental neutron activation analysis and atomic absorption spectroscopy were applied to the determination of trace element abundances in airborne particulate matter collected throughout Kinshasa, Zaire. Statistical treatment of the resulting data was used to assess the variations between sites and to identify the sources of the pollutants. 10 refs, 5 tabs.

3736 (IAEA-NAHRES–9, pp. 363-378) **Report on intercomparison of the determination of elemental concentrations in the air particulate samples collected on Whatman - 41 filters.** Negi, B.S. (Bhabha Atomic Research Centre, Trombay, Bombay (India). Environmental Assessment Div.); Sadasivan, S.; Nambi, K.S.V. International Atomic Energy Agency, Vienna (Austria). Section of Nutritional and Health-Related Environmental Studies. 1992. (CONF-9109445–: 3. research co-ordination meeting on the use of nuclear and nuclear-related techniques in the study of environmental pollution associated with solid wastes, Vienna (Austria), 10-13 Sep 1991). In *Co-ordinated research programme on the use of nuclear and nuclear-related techniques in the study of environmental pollution associated with solid wastes: Report on the third research co-ordination meeting, Vienna, Austria, 10-13 September 1991.* 381p. Order Number DE93606509. Source: OSTI; NTIS (US Sales Only); INIS.

This document reports an interlaboratory comparison of the determinations of elemental concentrations in air particulate samples. Most of the participants used neutron activation analysis, but a few used X-ray fluorescence, atomic absorption spectroscopy or PIXE analysis. The concentrations of 30 elements have been determined by more than one laboratory. 2 figs, tabs.

3737 (INIS-BR–2938) **Proceedings of the 7. Gondwana Symposium - Abstracts.** Sao Paulo Univ., SP (Brazil). Inst. de Geociencias. 1988 156p. (CONF-8807219–: 7. Gondwana symposium, Sao Paulo (Brazil), 18 Jul 1988). Order Number DE93606510. Source: OSTI; NTIS (US Sales Only); INIS.

This symposium presents the tectonic evolution of Gondwana land using radiometric analysis. Geochronological results and uranium occurrences in Gondwana sequences are also shown. (M.V.M.).

3738 (INIS-BR–2938, pp. 6) **The geotectonic setting of Eastern Brazil and West Africa during the Brazilian/Pan African orogeny.** Siga Junior, O. (Instituto Brasileiro de Geografia e Estatistica (IBGE), Sao Paulo, SP (Brazil)); Cordani, U.G.; Fonseca, A.C. Sao Paulo Univ., SP (Brazil). Inst. de Geociencias. 1988. 156p. (CONF-8807219–: 7. Gondwana symposium, Sao Paulo (Brazil), 18 Jul 1988). In *Proceedings of the 7. Gondwana Symposium - Abstracts.* Order Number DE93606510. Source: OSTI; NTIS (US Sales Only); INIS.

Published in summary form only. APATITES/age estimation; APATITES/fission tracks; APATITES/geology; GEOLOGY/tectonics; AFRICA; APATITES; GEOLOGY; BRAZIL; TECTONICS; IGNEOUS ROCKS; METAMORPHIC ROCKS; OROGENESIS

3739 (INIS-BR–2938, pp. 5) **Comparison of new Rb-Sr and K-Ar data from upper precambrian sedimentary sequences in Congo Republic with corresponding formations of Western Africa, Central Africa and Northeastern South America.** Bonhomme, M.G. (Universite Joseph Fourier, 69 - Grenoble (France). Inst. Dolomieu); Macedo, M.H.F.; N'Defi, H.D. Sao Paulo Univ., SP (Brazil). Inst. de Geociencias. 1988. 156p. (CONF-8807219–: 7. Gondwana symposium, Sao Paulo (Brazil), 18 Jul 1988). In *Proceedings of the 7. Gondwana Symposium - Abstracts.* Order Number DE93606510. Source: OSTI; NTIS (US Sales Only); INIS.

Published in summary form only. SEDIMENTS/comparative evaluations; SEDIMENTS/isotope dating; AFRICA; ARGON; DIAGENESIS; GEOCHEMISTRY; GEOLOGY; POTASSIUM; ROCKS; RUBIDIUM; SEDIMENTS; SOUTH AMERICA; STRATIGRAPHY; STRONTIUM

3740 (INIS-BR–2938, pp. 7) **Geochronological results on some granitoids from Benin and their bearing on the correlation Brazil/West Africa.** Cordani, U.G. (Sao Paulo Univ., SP (Brazil). Inst. de Geociencias); Kawashita, K.; Vancini, K.R.B.; Boriani, A.; Bigioggero, B.; Cadoppi, P.; Sacchi, L. Sao Paulo Univ., SP (Brazil). Inst. de Geociencias. 1988. 156p. (CONF-8807219–:

7. Gondwana symposium, Sao Paulo (Brazil), 18 Jul 1988). In *Proceedings of the 7. Gondwana Symposium - Abstracts.* Order Number DE93606510. Source: OSTI; NTIS (US Sales Only); INIS.

Published in summary form only. BIOTITE/isotope dating; GRANITES/isotope dating; AFRICA; ARGON; BIOTITE; BRAZIL; FELDSPARS; GEOCHEMISTRY; GEOLOGY; GRANITES; POTASSIUM; RADIOMETRIC ANALYSIS; RUBIDIUM; STRONTIUM

3741 (INIS-BR–2938, pp. 47) **Initiation of paleozoic cratonic basins of Western Gondwana land possibly associated with an upper Ordovician - lower Devonian distensible tectonics evidenced in Northern Cameroon.** Trompette, R. (Aix-Marseille-e Univ., 13 - Marseille (France). Lab. de Geologie Dynamique et Petrologie de la Surface). Sao Paulo Univ., SP (Brazil). Inst. de Geociencias. 1988. 156p. (CONF-8807219–: 7. Gondwana symposium, Sao Paulo (Brazil), 18 Jul 1988). In *Proceedings of the 7. Gondwana Symposium - Abstracts.* Order Number DE93606510. Source: OSTI; NTIS (US Sales Only); INIS.

Published in summary form only. TECTONICS/isotope dating; TECTONICS/sediments; ARGON; BRAZIL; CAMEROON; GEOCHEMISTRY; GEOLOGY; IGNEOUS ROCKS; POTASSIUM; TECTONICS; SEDIMENTS

3742 (INIS-BR–2938, pp. 51) **Paleomagnetic results from late Archean and early proterozoic granites from Kenya.** Petel, J.P. (Nairobi Univ., (Kenya). Dept. of Physics). Sao Paulo Univ., SP (Brazil). Inst. de Geociencias. 1988. 156p. (CONF-8807219–: 7. Gondwana symposium, Sao Paulo (Brazil), 18 Jul 1988). In *Proceedings of the 7. Gondwana Symposium - Abstracts.* Order Number DE93606510. Source: OSTI; NTIS (US Sales Only); INIS.

Published in summary form only. GRANITES/isotope dating; DEMAGNETIZATION; GRANITES; KENYA; MAGNETITE; RUBIDIUM; STRONTIUM; THERMOMAGNETISM

3743 (INIS-BR–2938, pp. 52) **Tectonic significance of paleozoic metamorphic and sedimentary rocks of coastal central Chile.** Rebolledo, S. (Chile Univ., Santiago (Chile). Dept. de Geologia y Geofisica); Charrier, R. Sao Paulo Univ., SP (Brazil). Inst. de Geociencias. 1988. 156p. (CONF-8807219–: 7. Gondwana symposium, Sao Paulo (Brazil), 18 Jul 1988). In *Proceedings of the 7. Gondwana Symposium - Abstracts.* Order Number DE93606510. Source: OSTI; NTIS (US Sales Only); INIS.

Published in summary form only. METAMORPHIC ROCKS/isotope dating; METAMORPHIC ROCKS/tectonics; SEDIMENTARY ROCKS/isotope dating; SEDIMENTARY ROCKS/tectonics; ARGON; CHILE; TECTONICS; POTASSIUM

3744 (INIS-BR–2938, pp. 54) **Proterozoic and Phanerozoic tectono-magmatic and tectono-thermal development in Neuschwabenland based on radiometric, Paleomagnetic and geochemical data of the magmatic sequences from the Ahlmannruecken and Vestfjella (Antarctica).** Petters, M. (IGDL, Goettingen (Germany)); Weber, K. Sao Paulo Univ., SP (Brazil). Inst. de Geociencias. 1988. 156p. (CONF-8807219–: 7. Gondwana symposium, Sao Paulo (Brazil), 18 Jul 1988). In *Proceedings of the 7. Gondwana Symposium - Abstracts.* Order Number DE93606510. Source: OSTI; NTIS (US Sales Only); INIS.

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3745 (INIS-BR–2938, pp. 69) **Presence of Gondwana ice sheet during the deposition of the Permo-Carboniferous formations, Beacon Supergroup, Trans antarctic Mountains.** Lord, B.K. (Ohio State Univ., Columbus, OH (USA). Bird Polar Research Center); Faure, G.; Jones, L.M. Sao Paulo Univ., SP (Brazil). Inst. de Geociencias. 1988. 156p. (CONF-8807219–: 7. Gondwana symposium, Sao Paulo (Brazil), 18 Jul 1988). In *Proceedings of the 7. Gondwana Symposium - Abstracts.* Order Number DE93606510. Source: OSTI; NTIS (US Sales Only); INIS.

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3746 (INIS-BR–2938, pp. 94) **Mid-paleozoic magmatism along the Antarctic peninsula segment of the Pacific margin of Gondwana.** Milne, A.J. (Natural Environment Research Council, Cambridge (UK). British Antarctic Survey). Sao Paulo Univ., SP (Brazil). Inst. de Geociencias. 1988. 156p. (CONF-8807219–: 7. Gondwana symposium, Sao Paulo (Brazil), 18 Jul 1988). In *Proceedings of the 7. Gondwana Symposium - Abstracts.* Order Number DE93606510. Source: OSTI; NTIS (US Sales Only); INIS.

Published in summary form only. GRANITES/isotope dating; ANTARCTIC REGIONS; BASALT; GEOCHEMISTRY; GEOLOGY; GRANITES; ISOTOPE RATIO; NIOBIUM; PETROLOGY; STRONTIUM 86; STRONTIUM 87; YTTRIUM

3747 (INIS-BR–2938, pp. 97) **Isotopic and geochemical studies of Ferrar dolerite sills in the Transatlantic Mountains.** Faure, G. (Ohio State Univ., Columbus, OH (USA). Bird Polar Research Center); Mensing, T.M.; Kibler, E.M.; Jones, L.M.; Hoefs, J. Sao Paulo Univ., SP (Brazil). Inst. de Geociencias. 1988. 156p. (CONF-8807219–: 7. Gondwana symposium, Sao Paulo (Brazil), 18 Jul 1988). In *Proceedings of the 7. Gondwana Symposium - Abstracts.* Order Number DE93606510. Source: OSTI; NTIS (US Sales Only); INIS.

Published in summary form only. PLUTONIC ROCKS/isotope dating; ANTARCTIC REGIONS; GEOLOGY; ISOTOPE RATIO; MOUNTAINS; OXYGEN 18; RUBIDIUM; STRONTIUM

3748 (INIS-BR–2938, pp. 98) **Evidence for cretaceous volcanism in Northern Victoria land, Antarctica, and implications for a mantle enrichment event during the Ross orogeny based on chemical and isotopic data from the Kirkpatrick basalt in the Mesa range.** Mensing, T.M. (Ohio State Univ., Columbus, OH (USA). Bird Polar Research Center); Faure, G.; Jones, L.M.; Hoefs, J. Sao Paulo Univ., SP (Brazil). Inst. de Geociencias. 1988. 156p. (CONF-8807219–: 7. Gondwana symposium, Sao Paulo (Brazil), 18 Jul 1988). In *Proceedings of the 7. Gondwana Symposium - Abstracts.* Order Number DE93606510. Source: OSTI; NTIS (US Sales Only); INIS.

Published in summary form only. BASALT/isotope dating; ANTARCTICA; ARGON; BASALT; ISOTOPE RATIO; POTASSIUM; RUBIDIUM; STRONTIUM; VICTORIA

3749 (INIS-BR–2938, pp. 109) **Relating late proterozoic continental distributions to the origin of mobile belts.** Onstott, T.C. (Princeton Univ., NJ (USA). Dept. of Geological and Geophysical Sciences). Sao Paulo Univ., SP (Brazil). Inst. de Geociencias. 1988. 156p. (CONF-8807219–: 7. Gondwana symposium, Sao Paulo (Brazil), 18 Jul 1988). In *Proceedings of the 7. Gondwana Symposium - Abstracts.* Order Number DE93606510. Source: OSTI; NTIS (US Sales Only); INIS.

Published in summary form only. ROCKS/isotope dating; ARGON 39; ARGON 40; RADIOMETRIC SURVEYS; ROCKS; STRATIGRAPHY

3750 (INIS-BR–2938, pp. 121) **New K-Ar ages on the metamorphic history of the Puncoviscana formation and equivalents, N W Argentina.** Adams, C. (Department of Scientific and Industrial Research, Lower Hutt (New Zealand). Inst. of Nuclear Sciences); Miller, H.; Toselli, A. Sao Paulo Univ., SP (Brazil). Inst. de Geociencias. 1988. 156p. (CONF-8807219–: 7. Gondwana symposium, Sao Paulo (Brazil), 18 Jul 1988). In *Proceedings of the 7. Gondwana Symposium - Abstracts.* Order Number DE93606510. Source: OSTI; NTIS (US Sales Only); INIS.

Published in summary form only. METAMORPHIC ROCKS/isotope dating; METAMORPHIC ROCKS/tectonics; ARGENTINA; ARGON; TECTONICS; POTASSIUM

3751 (INIS-BR–2942, pp. 31) **Determination of neutron double differential cross-section for calcined bakelite.** Voi, D.L. (Instituto de Engenharia Nuclear (IEN), Rio de Janeiro, RJ (Brazil). Div. de Fisica de Reatores); Brito Aghina, L.O. de; Borges, J.C.; Vinhas, L.A. Instituto de Engenharia Nuclear (IEN), Rio de Janeiro, RJ (Brazil). Dept. de Reatores. 1989. 147p. (CONF-871004–: International conference on the utilization of multi-purpose research reactors and related international co-operation, Grenoble (France), 19-23 Oct 1987). In *Triennial technical report - 1986, 1987, 1988 - Instituto de Engenharia Nuclear (IEN) -Dept. of Reactors (DERE).*

Order Number DE93605069. Source: OSTI; NTIS (US Sales Only); INIS.

Published in full form as CT-DIFIR 11/87.

Published in summary form only. BAKELITE/differential cross sections; RIEN-1 REACTOR/neutron spectroscopy; BAKELITE; BERYLLIUM; CALCINATION; INELASTIC SCATTERING; MOLECULAR STRUCTURE; NEUTRONS; TIME-OF-FLIGHT METHOD

3752 (INIS-BR–2943) **Brazil Geological Basic Survey Program - Lima Duarte - Sheet SF.23-X-C-VI - Minas Gerais State.** Pinto, C.P. Departamento Nacional de Producao Mineral (DNPM), Brasilia, DF (Brazil); Companhia de Pesquisas de Recursos Minerais (CPRM), Belo Horizonte, MG (Brazil). Superintendencia Regional de Belo Horizonte. 1991 224p. (In Portuguese). Order Number DE93606511. Source: OSTI; NTIS (US Sales Only); INIS.

The present report refers to the Lima Duarte sheet (SF.23-X-C-VI) systematic geological mapping, on the 1:100.000 scale. The surveyed area, localized in the Zona da Mata, Juiz de Fora microregion, in South Minas Gerais, is dominantly composed by metamorphic rocks of the granulite and amphibolite facies and presents important diphtheritic process. An analysis of the Crustal Evolution Patterns based mostly on geological mapping, and gravimetric, air magneto metric and geochronologic data is given in the Chapter 6, Part II, of the text. Geophysical information is in the Chapter 5, Part II. Seventy two samples were analysed for oxides, trace-elements and REE, to provide litho environment and metallogenesis definition subsidies. Were studied 174 petrographic thin section, and 48 samples of quartzite and schist residual materials were analysed for heavy metals. Seven hundred and fifty outcrops were described. A geochemical survey, based on 81 pan concentrated samples and 277 stream sediments was carried out throughout the Sheet. The anomalies found in the stream sediments reflect the geochemical signature of the analysed elements for the litho types of the investigated terrains. (author).

3753 (INIS-BR–2944) **Brazil Geological Basic Survey Program - Ponte Nova - Sheet SF.23-X-B-II - Minas Gerais State.** Brandalise, L.A. Departamento Nacional de Producao Mineral (DNPM), Brasilia, DF (Brazil); Companhia de Pesquisas de Recursos Minerais (CPRM), Belo Horizonte, MG (Brazil). Superintendencia Regional de Belo Horizonte. 1991 191p. (In Portuguese). Order Number DE93606512. Source: OSTI; NTIS (US Sales Only); INIS.

The present report refers to the Ponte Nova Sheet (SF.23-X-B-II) systematic geological mapping, on the 1:100.000 scale. The Sheet covers the Zona da Mata region, Minas Gerais State, in the Mantiqueira Geotectonic Province, to the eastern part of Sao Francisco Geotectonic Province, as defined in the project. The high grade metamorphic rocks to low amphibolite, occurring in the area were affected by a marked low angle shearing transposition, and show diphtheritic effects. Archaean to Proterozoic ages are attributed to the metamorphites mostly by comparison to similar types of the region. Three deformed events were registered in the region. Analysis of the crustal evolution pattern based on geological mapping, laboratorial analyses, gravimetric and air magnetometry data, and available geochronologic data is given in the 6. Chapter, Part II, in the text. Major element oxides, trace-elements, and rare-earths elements were analysed to establish parameters for the rocks environment elucidation. Geochemical survey was carried out with base on pan concentrated and stream sediments distributed throughout the Sheet. Gneisses quarries (industrial rocks) in full exploration activity have been registered, as well as sand and clay deposits employed in construction industry. Metallogenetic/ Provisional analysis points out the area as a favorable one for gold prospection. (author).

3754 (INIS-BR–2968) **First studies of lead pollution in Guanabara.** Silveira Branquinho, C.L. da. Universidade Federal, Rio de Janeiro, RJ (Brazil). Coordenacao dos Programas de Posgraduacao de Engenharia. 1973 123p. (In Portuguese). Order Number DE93606550. Source: OSTI; NTIS (US Sales Only); INIS.

The main sources of direct lead intake are studied, and metal concentrations in several medium are examined. Lead was extracted by dithizone in C Cl_4, being determined by optical spectrophotometry. $_{2\ 1\ 2}$ Pb was used as a radioactive tracer in low concentration measurements of the metal, and analysis of its 239 KeV peak was done by a Ge-Li detector. In blood samples, the metal was complexed and extracted with APDC in MIBK, being measured by flame less atomic absorption spectrophotometry. Air samples were also collected for periods of 24 hours and 90 minutes. Representative street dust samples were examined, showing a strict correlation with lead in air. It was also estimated the amount of lead in some human blood samples. (author).

3755 (INIS-BR–3000) **Synthesis and characterization of lanthanide picrate complexes with 4-picoline-N-oxide (4-pic N O).** Silva, E.M. da. Sao Paulo Univ., SP (Brazil). Inst. de Quimica. 1991 114p. (In Portuguese). Order Number DE93606551. Source: OSTI; NTIS (US Sales Only); INIS.

The lanthanide picrate complexes with 4-picoline-N-oxide were obtained from ethanolic solutions of the hydrated lanthanide picrate and the ligand. The lanthanide content was determined by complexometric titration with EDTA. Carbon, Nitrogen and Hydrogen were determined by microanalytical procedures. Chemical analysis of the lanthanide picrate complexes are also presented. (author).

3756 (INIS-BR–3014) **Thorium determination in water and biological materials by fission track.** Melo Ferreira, A.C. de. Pontificia Univ. Catolica do Rio de Janeiro, RJ (Brazil). Dept. de Quimica. 1989 156p. (In Portuguese). Order Number DE93606513. Source: OSTI; NTIS (US Sales Only); INIS.

As a segment of a research programme on the study of bioaccumulation of radionuclides, in animals and vegetables from Morro do Ferro, Pocos de Caldas, MG, a fission track method for the determination of low levels of thorium in environmental samples was developed as an alternative for alpha spectroscopy. The study was carried out in early alpha spectroscopy samples, containing high levels of ^{228} Th activity, which makes difficult the ^{232} Th determination. A dry way method for thorium evaluation was developed. Pieces of membrane filters, containing La F_3 (Th), coupled to Makrofol detectors, were irradiated in the core of a research reactor, IEA-R1 (IPEN). (author).

3757 (INIS-BR–3027) **Development of conjugate methods with gas chromatography for inorganic compounds analysis.** Baccan, N. Universidade Estadual de Campinas, SP (Brazil). Inst. de Quimica. 1975 157p. (In Portuguese). Order Number DE93606552. Source: OSTI; NTIS (US Sales Only); INIS.

The application of gas chromatography combined with mass spectrometry or with nuclear methods for the analysis of inorganic compounds is studied. The advantages of the use of a gas chromatograph coupled with a quadrupole mass spectrometer or with a high resolution radiation detector, are discussed. We also studied the formation and solvent extraction of metal chelates; an aliquot of the organic phase was directly injected into the gas chromatograph and the eluted compounds were detected by mass spectrometry or, when radioactive, by nuclear methods. (author).

3758 (INIS-BR–3040) **Geology, petrography and geochronology of meridional and oriental regions from Morungaba complex, SP.** Vlach, S.R.F. Sao Paulo Univ., SP (Brazil). Inst. de Geociencias. 1985 273p. (In Portuguese). Order Number DE93606514. Source: OSTI; NTIS (US Sales Only); INIS.

The Morungaba Granitoid Complex, covering about 330 km^2, crops out as an elongate irregular Massif trending SW-NE, in the southeast part of the State of Sao Paulo, southeast Brazil. Major constituents are biotite granitoids with subordinate diorites. Over thirty facies types, each with distinctive structural-petrographic features, were recognized during detailed mapping of part of the Massif (about 200 km^2), and mapped as groups of facies. Geochronological Rb/Sr data for several groups of associated facies are also presented. (author).

3759 (INIS-mf–13375, pp. 37) **Absolute determination of uranium concentration and Ra/U ratio in uranium ores by gamma ray spectroscopy.** Abdel-Aziz, M.M.; Fadel, M.O.; Hasnawi, A. Tajoura Nuclear Research Centre, Tripoli (Libyan Arab Jamahiriya). 1984. 82p. (CONF-8409421–: Seminar on the use of research reactors in fundamental and applied sciences, Tajoura (Libyan Arab Jamahiriya), 16 Sep 1984). In *Seminar on the use of research reactors in fundamental and applied sciences. Programme*

and abstracts. Order Number DE93606515. Source: Also available from Tajoura Nuclear Research Centre, Tajoura/Tripoli, Libya.

Short communication. URANIUM ORES/isotope ratio; GAMMA SPECTROSCOPY; POTASSIUM 40; RADIUM 226; THORIUM 232; URANIUM 235; URANIUM 238

3760 (INIS-mf–13375, pp. 39) **Use of research reactors in radioanalysis present situation and the outlook for the future.** Das, H.A. Tajoura Nuclear Research Centre, Tripoli (Libyan Arab Jamahiriya). 1984. 82p. (CONF-8409421–: Seminar on the use of research reactors in fundamental and applied sciences, Tajoura (Libyan Arab Jamahiriya), 16 Sep 1984). In *Seminar on the use of research reactors in fundamental and applied sciences. Programme and abstracts.* Order Number DE93606515. Source: Also available from Tajoura Nuclear Research Centre, Tajoura/Tripoli, Libya.

Short communication. NEUTRON ACTIVATION ANALYSIS; RESEARCH REACTORS; REVIEWS

3761 (INIS-mf–13375, pp. 40) **Determination of uranium and thorium in geological samples by means of the activation method using the neutron generator and reactor.** El-Barouni, A.M. (Tajoura Nuclear Research Centre, Tajoura/Tripoli (Libya)); Moussa, M.B.; Nikolaenko, O.K. Tajoura Nuclear Research Centre, Tripoli (Libyan Arab Jamahiriya). 1984. 82p. (CONF-8409421–: Seminar on the use of research reactors in fundamental and applied sciences, Tajoura (Libyan Arab Jamahiriya), 16 Sep 1984). In *Seminar on the use of research reactors in fundamental and applied sciences. Programme and abstracts.* Order Number DE93606515. Source: Also available from Tajoura Nuclear Research Centre, Tajoura/Tripoli, Libya.

Short communication. URANIUM ORES/neutron activation analysis; FISSION NEUTRONS; NEUTRON GENERATORS; THORIUM 232; URANIUM 238

3762 (INIS-mf–13375, pp. 41-42) **Current aspects of multielement analysis in the life sciences and their applicability to research work at Tajoura Research Centre.** Michel, R. (Patti GmbH (Germany)). Tajoura Nuclear Research Centre, Tripoli (Libyan Arab Jamahiriya). 1984. 82p. (CONF-8409421–: Seminar on the use of research reactors in fundamental and applied sciences, Tajoura (Libyan Arab Jamahiriya), 16 Sep 1984). In *Seminar on the use of research reactors in fundamental and applied sciences. Programme and abstracts.* Order Number DE93606515. Source: Also available from Tajoura Nuclear Research Centre, Tajoura/Tripoli, Libya.

Short communication. NEUTRON ACTIVATION ANALYSIS/multielement analysis; BODY FLUIDS; MILK; NUTRIENTS; TISSUES

3763 (INIS-mf–13375, pp. 30) **Isotropic determination of nitrogen in ammonia by Fourier transform infrared spectroscopy.** Abuzwida, M.A. (Tajoura Nuclear Research Centre, Tajoura/Tripoli (Libya)); Moser, H.C. Tajoura Nuclear Research Centre, Tripoli (Libyan Arab Jamahiriya). 1984. 82p. (CONF-8409421–: Seminar on the use of research reactors in fundamental and applied sciences, Tajoura (Libyan Arab Jamahiriya), 16 Sep 1984). In *Seminar on the use of research reactors in fundamental and applied sciences. Programme and abstracts.* Order Number DE93606515. Source: Also available from Tajoura Nuclear Research Centre, Tajoura/Tripoli, Libya.

Short communication. AMMONIA/infrared spectra; AMMONIA/isotope ratio; AMMONIA; FOURIER TRANSFORMATION; NITROGEN 14; NITROGEN 15

3764 (INIS-mf–13375, pp. 27) **Synthesis of complexing sorbents and their use in chromatographical analysis of metal ion.** Abdunabi, H.; Turki, A.; Zoltaryov, Yu. Tajoura Nuclear Research Centre, Tripoli (Libyan Arab Jamahiriya). 1984. 82p. (CONF-8409421–: Seminar on the use of research reactors in fundamental and applied sciences, Tajoura (Libyan Arab Jamahiriya), 16 Sep 1984). In *Seminar on the use of research reactors in fundamental and applied sciences. Programme and abstracts.* Order Number DE93606515. Source: Also available from Tajoura Nuclear Research Centre, Tajoura/Tripoli, Libya.

Short communication. ADSORBENTS/chemical preparation; URANIUM IONS/chemisorption; ADSORBENTS; ORGANIC ION EXCHANGERS; CHEMISORPTION

3765 (INIS-mf–13375, pp. 43) **Simultaneous determination of nitrogen, phosphorus, potassium and silicon content in fertilizers and plant samples using 14-MeV neutron activation analysis.** Kafala, S.I. (Department of Activation Analysis, Tajoura Nuclear Research Centre, Tripoli (Libya)); Anisimov, B.V.; Tolkachev, I.V. Tajoura Nuclear Research Centre, Tripoli (Libyan Arab Jamahiriya). 1984. 82p. (CONF-8409421–: Seminar on the use of research reactors in fundamental and applied sciences, Tajoura (Libyan Arab Jamahiriya), 16 Sep 1984). In *Seminar on the use of research reactors in fundamental and applied sciences. Programme and abstracts.* Order Number DE93606515. Source: Also available from Tajoura Nuclear Research Centre, Tajoura/Tripoli, Libya.

Short communication. FERTILIZERS/neutron activation analysis; NEUTRON ACTIVATION ANALYSIS/multi-element analysis; PLANTS/neutron activation analysis; FERTILIZERS; NITROGEN; PHOSPHORUS; PLANTS; POTASSIUM; SILICON

3766 (INIS-mf–13375, pp. 44) **Neutron activation techniques for uranium, thorium, and multielement analysis.** Papadopoulos, N.N. (Nuclear Research Centre Demokritos, Athens (Greece)). Tajoura Nuclear Research Centre, Tripoli (Libyan Arab Jamahiriya). 1984. 82p. (CONF-8409421–: Seminar on the use of research reactors in fundamental and applied sciences, Tajoura (Libyan Arab Jamahiriya), 16 Sep 1984). In *Seminar on the use of research reactors in fundamental and applied sciences. Programme and abstracts.* Order Number DE93606515. Source: Also available from Tajoura Nuclear Research Centre, Tajoura/Tripoli, Libya.

Short communication. NEUTRON ACTIVATION ANALYSIS; URANIUM/neutron activation analysis; THORIUM/neutron activation analysis; MULTI-ELEMENT ANALYSIS; URANIUM; THORIUM

3767 (JINR-R–14-91-458) **The determination of the thickness of the film materials by the PIXE method.** Blokhin, S.M. (Rostovskij-na-Donu Gosudarstvennyj Univ., Rostov-na-Donu (Russian Federation)); Vlasov, A.A.; Kobzev, A.P.; Shirokov, D.M. Joint Inst. for Nuclear Research, Dubna (Russian Federation). Lab. of Neutron Physics. 1991. 7p. (In Russian). Order Number DE93607555. Source: OSTI; NTIS (US Sales Only); INIS.

The method for the determination of the thickness of a homogeneous film based on the particle induced X-ray emission (PIXE) technique is described. Different variants of the given method with the use of a standard sample and without one as well as the case of measuring a relative change of a thickness are discussed. The results of the determination of the ZnO films thickness in comparison with the measurements conducted by the backscattering and optical methods are presented. 7 refs.; 1 fig.; 3 tabs.

3768 (KAERI/AR–333/91) **Applications of optical fiber to remote laser fluorescence analysis.** Kim, Cheol Jung (Korea Atomic Energy Research Inst., Daeduk (Korea, Republic of)); Shin, Jang Soo; Lee, Sang Mock; Kim, Jeong Moog; Kim, Duk Heon; Hong, Seok Kyung. Korea Atomic Energy Research Inst., Daeduk (Korea, Republic of). Dec 1991. 89p. (In Korean). Order Number DE93607553. Source: OSTI; NTIS (US Sales Only); INIS.

Fluorescence analysis using time-resolved laser fluorimetry has been used for trace uranium analysis because this method shows high sensitivity and low detection limit and is less matrix dependent than any other fluorimetric measurement. By this time, the uranium analyses in the solution of reprocessing process or high radioactive area have been primarily analyzed by sampling of the solution, but recently, a study on a remote uranium fluorescence analysis using optical fiber has been setting out based on the development of an optical fiber with radiation resistivity and of an advanced laser excitation source. Laser fluorimetry developed by our laboratory for trace uranium analyses in uranium handling process or in urine samples of workers in a nuclear facility has been used in our institute since 1988. A development of the system for remote control of uranium fluorescence analysis will be expected to contribute to an on-line uranium concentration monitoring in the cooling water of reconversion stream. In this report, we summarize the information related to fluorescence analyses and remote fluorescence monitoring methods established by foreign countries and our laboratory. We also present a future research direction for remote on-line monitoring of uranium in conversion or reconversion process. (Author).

3769 (KAERI-NEMAC/RR–39/91) **Basic chemistry for radioactive waste management: Development of chemical methods on geological material analysis.** Eom, Tae Yoon (Korea Atomic Energy Research Inst., Daeduk (Korea, Republic of)); Kim, Sung Soo; Kim, Jeong Seok; Park, Soon Dal; Park, Yong Jun; Seo, Moo Yeul; Sohn, Se Chul; Song, Byung Chul; Lee, Chang Heun; Jun, Young Shin. Korea Atomic Energy Research Inst., Daeduk (Korea, Republic of). Mar 1992. 217p. (In Korean). Order Number DE93607141. Source: OSTI; NTIS (US Sales Only); INIS.

Chemical analysis on geological materials was performed for radioactive waste management. Seven major elements including Mn, Fe in JG-2, DWC-I, W-2 and BIR standard samples were determined by acid digestion decomposition and fusion method with sodium carbonate, respectively. About 40 trace elements including Na were determined by instrumental neutron activation analysis method. Retention times of lanthanides were measured by ion chromatography using α-hydroxyisobutyric acid and mandelic acid, respectively. This result gave good agreement between the measured value and the calculated by stepwise elution equation. Trace amount of gallium and indium in natural water were analysed by adsorptive stripping voltammetry using Morin as chelating agent. Detection limit of gallium and indium were 1.1 nM nd 2.6 nM in each. Low level of H-3 and C-14 in natural water were measured by liquid scintillation counting technique. Minimum detectable activity(MDA) by this method were shown to be 0.722 Bq/L and 0.111 Bq/L. (Author).

3770 (LA–12246) **Evaluation of chloride-ion-specific electrodes as in situ chemical sensors for monitoring total chloride concentration in aqueous solutions generated during the recovery of plutonium from molten salts used in plutonium electrorefining operations.** Smith, W.H. Los Alamos National Lab., NM (United States). Oct 1992. 12p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. Order Number DE93002158. Source: OSTI; NTIS; INIS; GPO Dep.

Two commercially available chloride-ion-specific electrodes (CLISEs), a solid-state type and a membrane type, were evaluated as potential in situ chemical sensors for determining total chloride ion concentration in mixed sodium chloride/potassium chloride/hydrochloric acid solutions generated during the recovery of plutonium from molten salts used in plutonium electrorefining operations. Because the response of the solid-state CLISE was closer than was the response of the membrane-type CLISE to the theoretical response predicted by the Nernst equation, the solid-state CLISE was selected for further evaluation. A detailed investigation of the characteristics of the chloride system and the corresponding CLISE response to concentration changes suggested four methods by which the CLISE could be used either as a direct, in situ sensor or as an indirect sensor through which an analysis could be performed on-line with a sample extracted from the process solution.

3771 (LA–12426-MS) **A study of intrinsic densitometry using the Monte Carlo method.** Henriksen, P.W. (ed.); Collins, M.L.; Hsue, S.T. Los Alamos National Lab., NM (United States). Oct 1992. 10p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. Order Number DE93000827. Source: OSTI; NTIS (US Sales Only); GPO Dep.

The intrinsic densitometry (ID) technique is one way to measure the concentration of plutonium in a liquid solution. A device that implements the intrinsic densitometry technique was modeled in two ways: A mathematical model (on computer spreadsheet) and a Monte Carlo particle-transport simulation (on a supercomputer). The mathematical model was used to predict the performance of the ID system. A Monte Carlo code was used to perform experiments upon a computer model of the same system. Observed results from the Monte Carlo experiments were compared with those predicted by the mathematical model. For this system, at the extremes of the concentration range tested, the Monte Carlo results and the predicted values differed by 1%.

3772 (LBL–32129) **Determination of the strain field from an HREM image of a Si Lomer dislocation.** Tsai, K.H. (Brown Univ., Providence, RI (United States). Div. of Engineering); Schwartzman, A.F.; Gallego, R.; Ortiz, M.; Kim, K.S.; O'Keefe, M.A. Lawrence Berkeley Lab., CA (United States). Mar 1992. 3p. Sponsored by USDOE, Washington, DC (United States); Department of Defense, Washington, DC (United States); National Science Foundation, Washington, DC (United States). DOE Contract AC03-76SF00098. Grant N00014-90-J-1295;Grant DMR-9002994. (CONF-920819–23: Annual meeting of the Electron Microscopy Society (EMS) of America, Boston, MA (United States), 16-21 Aug 1992). Order Number DE92041176. Source: OSTI; NTIS; GPO Dep.

Extended abstract.

A new approach to quantitative deformation characterization of high-resolution electron microscopy (HREM) defect images has been developed. The principle of this technique, (Computational Fourier Transform Deformation (CFTD)) is to extract an accurate displacement field about a defect from its HREM image using Fourier transformation procedures. The methodology's unique feature is to digitize the defect image and compute the Moire pattern, from which the displacement field is obtained, without the need for an external reference lattice image, normally associated with the interference phenomena. From this data, the displacement gradient can be calculated, which yields much information on the experimental deformation mechanics. One question that has arisen is whether different imaging conditions of the same defect affects the results of the CFM analysis. We have studied this problem by analyzing the strain components of simulated images of a Lomer dislocation in Si and present our findings here.

3773 (MLM–3768) **Mound activities in chemical and physical research: January–December 1991.** Mound, Miamisburg, OH (United States). 30 Nov 1992. 47p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-88DP43495. Order Number DE93004027. Source: OSTI; NTIS; GPO Dep.

The seven papers are grouped into four sections: data treatment, calculations in plutonium chemistry, separation research, and transport property research. Separate abstracts were prepared for all 7 papers.

3774 (PNL-SA–21259) **Detection of organic sulfur by ^{15}N and ^{19}F NMR via formation of iminosulfuranes.** Franz, J.A.; Linehan, J.C.; Lamb, C.N. Pacific Northwest Lab., Richland, WA (United States). Aug 1992. 8p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. (CONF-920815–10: 204. American Chemical Society (ACS) national meeting, Washington, DC (United States), 23-28 Aug 1992). Order Number DE93001511. Source: OSTI; NTIS; GPO Dep.

We have synthesized new iminosulfuranes from a variety of diaryl-and dialkyl sulfides and dibenzothiophene. The pattern of ^{15}N chemical shifts indicates that functional groups attached to sulfur are not simply resolved into aryl and alkyl groups. Thus, resolution of sulfur functional groups using ^{15}N NMR via iminosulfurane does not appear practicable. However, iminosulfurane formation, together with the N-haloamide reaction and the Pummerer rearrangement, provides pathways for chemical discrimination of different sulfur substituents using unique ^{15}N- or, ^{19}F-labelled fragments for different categories of sulfur functional groups. In efforts currently underway, we are applying these reactions to methylated extracts and conversion products of the high-organic-sulfur containing Yugoslavian Rasa and Spanish Mequinenza lignites. 1 tab, 14 refs.

3775 (WSRC-RP–92-775) **DWPF ammonium ion analysis.** Eibling, R.E. Westinghouse Savannah River Co., Aiken, SC (United States). 5 Jun 1992. 8p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC09-89SR18035. Order Number DE93002171. Source: OSTI; NTIS; INIS; GPO Dep.

Ammonium nitrate production during the operation of the Defense Waste Processing Facility (DWPF) has been identified as a major problem. The accumulation of ammonium nitrate deposits in the vent system of the chemical processing cell has substantial safety implications and will require analysis of ammonium ions within DWPF process samples. As a part of the research and development of the DWPF at TNX, an ammonium analysis method developed by Dionex Corporation has been identified and confirmed to provide the required information. This memorandum describes the technical basis of the method, the accuracy and precision of the method, known interferences, and maintenance details.

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Refer also to citation(s) 2592, 2623, 2927, 2966, 2978, 3541, 3575, 3583, 3588, 3617, 3649, 3773, 3837, 3851, 3852, 3854, 3856, 3861, 3865, 3867, 3873, 3874, 4065, 4199, 4279

3776 (CONF-921110–30) **Predicting viscosities of aqueous salt mixtures.** Zaltash, A.; Ally, M.R. Oak Ridge National Lab., TN (United States). [1992]. 9p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. From Winter annual meeting of the American Society of Mechanical Engineers (ASME); Anaheim, CA (United States); 8-13 Nov 1992. Order Number DE93002421. Source: OSTI; NTIS; GPO Dep.

Viscosity plays an important role in quantifying heat and mass transfer rates as depicted in theoretical and semi-empirical correlations. In practical problems where extreme temperatures and solute concentrations are encountered, viscosity data is usually unavailable. At these conditions, no dependable correlation appears to exist in the literature. This paper uses the hole type model to predict the viscosity of aqueous electrolytes containing single and mixed salts up to the molten salt regime. This model needs two parameters which can be evaluated from sparse data. For LiBr/water and (Li, K, na) NO_3/water mixtures, it is shown that the agreement between predicted and experimental values is very good over wide temperature and concentration ranges. The deviation between these two values was found to be less than 9%.

3777 (DOE/ER/13289–6) **Model studies of hydrodesulfurization by Mo: Annual technical progress report, December 1, 1991–November 30, 1992.** Friend, C.M. Harvard Univ., Cambridge, MA (United States). Dept. of Chemistry. [1992]. 8p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG02-84ER13289. Order Number DE93002774. Source: OSTI; NTIS; GPO Dep.

Effects of surface modifiers (Co, S) on activity and selectivity of Mo(110) for desulfurization processes were studied. S generally increases the selectivity for desulfurization while decreasing overall reactivity. Co promots C-H activation processes on Mo(110). The Mo(110)-(9x2)-Co surface affects the desulfurization of 2,5- dihydrothiophene and methanethiol. Vibrational spectroscopy is being used for determining molecular orientation; vibrational frequencies were calculated for four labeled 2-propoxide isomers on Mo(110) and found to agree with experiment.

3778 (DOE/ER/13295–6) **[Transition metal mediated transformations of small molecules]: Progress report.** Sen, A. Pennsylvania State Univ., University Park, PA (United States). [1992]. 22p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG02-84ER13295. Order Number DE93001725. Source: OSTI; NTIS; GPO Dep.

Work on organotransition metal chemistry, homogeneous and heterogeneous catalysis is summarized. Several cationic palladium(II) complexes with bulky phosphine or pyridine ligands were discovered that are highly selective catalysts for linear dimerization of vinyl monomers and linear polymerization of p-divinylbenzene, the reactions proceeding through a carbocationic mechanism. Our studies were continued on alternating olefin-carbon monoxide copolymers. The copolymerization reaction and reactivity of copolymers were examined. New catalytic systems for alternating copolymerization of α-olefins with CO were discovered. In the case of styrene derivatives, tactic copolymers were obtained. Poly(ethylenepyrrolediyl) derivatives were synthesized from alternating ethylene-carbon monoxide copolymer and become electronic conductors when doped with iodine. A catalytic system for direct synthesis of polyureas and polyoxamides from and diamines was also discovered. Pt metal catalyzed the oxidation of ethers, esters, and amines to carboxylic acids and the oxidation of olefins to 1,2-diols. Anaerobic and aerobic decomposition of molybdenum(VI)-oxoalkyl compounds were studied for heterogeneous oxidation of alkanes and olefins on Mo(VI)-oxide surfaces. Synthesis of polymer-trapped metal, metal oxide, and metal sulfide nanoclusters (size <1–10 nm) was studied.

3779 (DOE/ER/13317–T3) **Studies relevant to the catalytic activation of carbon monoxide: Technical progress report, September 1991.** Ford, P.C. California Univ., Santa Barbara, CA (United States). Dept. of Chemistry. 4 Jun 1992. 8p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG03-85ER13317. Order Number DE93003267. Source: OSTI; NTIS; GPO Dep.

Research activity during the 1991–1992 funding period has been concerned with the following topics relevant to carbon monoxide activation. (1) Exploratory studies of water gas shift catalysts heterogenized on polystyrene based polymers. (2) Mechanistic investigation of the nucleophilic activation of CO in metal carbonyl clusters. (3) Application of fast reaction techniques to prepare and to investigate reactive organometallic intermediates relevant to the activation of hydrocarbons toward carbonylation and to the formation of carbon-carbon bonds via the migratory insertion of CO into metal alkyl bonds.

3780 (DOE/ER/13323–7) **Highly nucleophilic acetylide, vinyl, and vinylidene complexes: Progress report.** Pennsylvania State Univ., University Park, PA (United States). Dept. of Chemistry. 15 Jun 1992. 9p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG02-85ER13323. Order Number DE93004560. Source: OSTI; NTIS; GPO Dep.

The research was divided into the following: studies of nucleophilic and chiral acetylide complex $[Cp(CO)(PPh_3)Mn\text{-}C{\equiv}CR]^-$; nucleophilic addition of carbene anions to organic ligands on electrophilic complexes; halide-promoted carbonylation of imido ligands; binuclear Fe_2 complexes with bridging organonitrogen ligands; addition and cycloaddition reactions of carbyne complex $[Cp(CO)_2Re{\equiv}CTol]^+$; addition and cycloaddition reactions of methylcarbyne complexes $[Cp(CO)_2M{\equiv}CCH_3]^+$ and vinylidene complexes $Cp(CO)_2M{=}C{=}CH_2$ (M=Mn, Re); studies of generation and reactivity of vinylcarbene complexes formed from reaction of manganese carbene anions and aldehydes; and addition of oxo ligands of nucleophilic oxo complexes to organic ligands on electrophilic metal centers.

3781 (DOE/ER/13406–7) **Organometallic chemistry of bimetallic compounds: [Annual report].** Casey, C.P. Wisconsin Univ., Madison, WI (United States). Jul 1992. 5p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG02-85ER13406. Order Number DE93002773. Source: OSTI; NTIS; GPO Dep.

Hydrogenation of alkynes by the heterobimetallic compound $C_5H_5(CO)_2Re(\mu\text{-}H)Pt(H)(PPh_3)_2$ is being studied. The compound $C_5Me_5(CO)_2Re{=}Re(CO)_2C_5Me_5$ was synthesized; its chemistry is being studied. Compounds discovered in a reinvestigation of a spurious report of $(C_5Me_5)Co{=}Co(C_5Me_5)$, are being studied. The deuterioformylation of alkenes using wide bite angle phosphines will be studied.

3782 (DOE/ER/13501–T2) **Chemical activation of molecules by metals: Experimental studies of electron distributions and bonding: Progress report, March 1, 1992–September 30, 1992.** Lichtenberger, D.L. Arizona Univ., Tucson, AZ (United States). Dept. of Chemistry. [1992]. 7p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG02-86ER13501. Order Number DE93002366. Source: OSTI; NTIS; GPO Dep.

Purpose of this research program is to obtain experimental information on the different fundamental ways metals bond and activate organic molecules. Our approach has been to directly probe the electronic interactions between metals and molecules through a wide variety of ionization spectroscopies and other techniques, and to investigate the relationships with bonding modes, structures, and chemical behavior. During this period, we have (1) characterized the electronic features of diphosphines and monophosphines in their coordination to metals, (2) carried out theoretical and experimental investigations of the bonding capabilities of C_{60} to transition metals, (3) developed techniques for the imaging of single molecules on gold substrates that emphasizes the electronic backbonding from the metal to the molecule, (4) obtained the high resolution photoelectron spectrum of pure C_{70} in the gas phase, (5) compared the bonding of η^3- acetylide ligands to the bonding of other small organic molecules with metals, and (6) reported the photoelectron spectra and bonding of η^3-cyclopropenyl groups to metals.

3783 (DOE/ER/13603–5) **Study of intermediates from transition metal excited-state electron-transfer reactions: Progress report, August 1, 1989–December 31, 1991.** Hoffman, M.Z. Boston Univ., MA (United States). Dept. of Chemistry. 31 Dec 1991. 19p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG02-86ER13603. Order Number DE93001682. Source: OSTI; NTIS; GPO Dep.

During this period, conventional and fast-kinetics techniques of photochemistry, photophysics, radiation chemistry, and electrochemistry were used for the characterization of the intermediates that are involved in transition metal excited-state electron-transfer reactions. The intermediates of interest were the excited states of Ru(II) and Cr(III) photosensitizers, their reduced forms, and the species formed in the reactions of redox quenchers and electron-transfer agents. Of particular concern has been the back electron-transfer reaction between the geminate pair formed in the redox quenching of the photosensitizers, and the dependence of its rate on solution medium and temperature in competition with transformation and cage escape processes.

3784 (DOE/ER/13650–2) **The effect of catalyst preparation on catalytic activity: Final report, December 1, 1988–June 30, 1992.** Schwarz, J.A. Syracuse Univ., NY (United States). Dept. of Chemical Engineering and Materials Science. [1992]. 14p. Sponsored by USDOE, Washington, DC (United States); National Science Foundation, Washington, DC (United States). DOE Contract FG02-87ER13650. Grant CTS-8900514. Order Number DE93003890. Source: OSTI; NTIS; GPO Dep.

Three intrinsically connected phenomena occur during adsorption/impregnation of aqueous electrolytes onto oxide carriers. They are: pH-dependent development of surface carriers on the oxide; pH-dependent aqueous speciation of catalytic precursors; surface adsorption by complexation and coordination. Modeling of these processes yields basic thermodynamic properties of the adsorbed phase, which could provide useful information of the catalytic properties of the metal, support, and reveal metal-support interactions, thus contributing to design criteria for supported-metal catalysts. The spectrum of catalytic systems that can be studied using the above approach is greatly extended when both pure and composite oxide carriers are considered. This presentation will focus on three metal/support systems, each of which provides results of both practical and fundamental importance.

3785 (DOE/ER/13725–6) **Solid state, surface and catalytic studies of oxides: Annual progress report, January 1, 1992–December 31, 1992.** Kung, H.H. Northwestern Univ., Evanston, IL (United States). Dept. of Chemical Engineering. 7 Dec 1992. 15p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG02-87ER13725. Order Number DE93004640. Source: OSTI; NTIS; GPO Dep.

The properties of oxide catalysts that determine selectivity in oxidation of alkanes were investigated. Upon examining the product distribution in the oxidation of ethane, propane, butane, pentane, and cyclohexane over Mg orthovanadate, Mg pyrovanadate, and vanadyl pyrophosphate, it was found that whether dehydrogenation, formation of oxygen-containing organic products, or combustion was the predominant reaction depended on the catalyst and alkane. The product distribution could be explained by considering whether the active sites contained easily removable lattice oxygen ions, and whether the size of the alkane molecule was sufficiently large to be bonded to two adjacent vanadium ions in the active site to enhance the probability of reaction between the adsorbed hydrocarbon intermediate and reactive lattice oxygen. Selectivity for oxidative dehydrogenation of butane on silica-supported vanadium oxide depended on the vanadia loading. The selectivity was much higher on a 1 wt.% than on a 10 Wt-% V_2O_5/SiO_2 sample. It was also found that on the 10 wt.% sample, agglomeration of vanadia into V_2O_5 crystallites occurred during reaction. Results suggested that isolated VO_4 units were more selective for dehydrogenation of butane, consistent with the idea that the selectivity depended on the availability of reactive oxygen in the active site.

3786 (DOE/ER/13781–6) **[Studies of supported hydrodesulfurization catalysis]: Progress report.** Pittsburgh Univ., PA (United States). [1992]. 6p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG02-87ER13781. Order Number DE93004146. Source: OSTI; NTIS; GPO Dep.

Research progress is in three areas. First, correlation of the distribution of molybdenum oxidation states in reduced Mo/Al_2O_3 catalysts with benzene hydrogenation activity. Second, the use of factor analysis curve-fitting to determine the distribution of molybdenum oxidation states educed Mo/TiO_2 catalysts. Third, quantitative Raman and ESCA characterization of W/TiO_2 catalysts.

3787 (DOE/ER/13825–8) **Thermodynamics and transport in microporous media: Progress report.** Glandt, E.D. Pennsylvania Univ., Philadelphia, PA (United States). Dept. of Chemical Engineering. Sep 1992. 7p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG02-88ER13825. Order Number DE93004370. Source: OSTI; NTIS; GPO Dep.

Focus of this report is on the thermodynamic properties/behavior of fluids contained or adsorbed on the random microporus materials (disordered solids). The Madden-Glandt formalism for fluids in disordered matrices is applied to realistic systems (gas adsorption in carbons, polymer partitioning). Work on microgeometry of solids and their percolation and connectedness properties was continued; a study of the simplest model for microporous materials (random-pore or "Swiss cheese" model) was completed. Work on irreversible adsorption was continued; a simple model for correlated adsorption was studied.

3788 (DOE/ER/13849–5) **Low energy ion-molecule reactions and chemionization kinetics: Progress report, February 1, 1992–January 31, 1993.** Farrar, J.M. Rochester Univ., NY (United States). 24 Sep 1992. 10p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG02-88ER13849. Order Number DE93002237. Source: OSTI; NTIS; GPO Dep.

Objective is to understand dynamics of elementary ionic collisions at the level of the underlying potential surface by measuring energy and angular distributions of reactively scattered products with crossed beam methods over the relative center-of-mass energy range from 0.3 to several eV. During the past few years, emphasis was on reaction dynamics of anionic species important in combustion, with special emphasis on O^- in proton and hydrogen atom transfer reactions with NH_3, H_2O, HF, and CH_4.

3789 (DOE/ER/13855–T1) **Stable isotope studies: Final report, March 1, 1972–February 29, 1992.** Ishida, T. City Univ. of New York, NY (United States). Research Foundation; State Univ. of New York, Stony Brook, NY (United States). Research Foundation. [1992]. 97p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG02-88ER13855. Order Number DE93000908. Source: OSTI; NTIS; INIS; GPO Dep.

The research has been in four general areas: (1) correlation of isotope effects with molecular forces and molecular structures, (2) correlation of zero-point energy and its isotope effects with molecular structure and molecular forces, (3) vapor pressure isotope effects, and (4) fractionation of stable isotopes. 73 refs, 38 figs, 29 tabs.

3790 (DOE/ER/13880–5) **Late transition metal oxo and imido complexes: Progress report, May 15 1992–May 14, 1992.** Sharp, P.R. Missouri Univ., Columbia, MO (United States). Dec 1992. 4p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG02-88ER13880. Order Number DE93004650. Source: OSTI; NTIS; GPO Dep.

A range of new phosphine Au(I) oxo complexes, $[(LAu)_3(\mu\text{-}O)]^+$, were prepared, testing the limits of the phosphine steric and electronic properties. Their reaction with reducing agents (hydrazines, CO and RNC) give a variety of new and known gold clusters in unprecedented high yields and establish the steric and electronic relationships between the phosphine and the nuclearity of the product Au cluster. The $[L_2Pt(\mu\text{-}O)]_2$ class of dioxo complexes has been expanded to include the first anionic oxo complex, $([(dppm\text{-}H)Pt(\mu\text{-}O)]_2)Li_2$ and the first Pt imido complexes, $[(L_2Pt)_2(\mu\text{-}O)(\mu\text{-}NR)]$ and $[L_2Pt(\mu\text{-}NR)]_2$. The previously observed Rh imido/amido A-frame chemistry has been extended to Ir. The p-MePh-imido complex has been characterized by X-ray diffraction and clearly shows the resonance delocalization of the nitrogen lone pair into the aryl ring which is responsible for the previously observed electrophilic ring addition and oxidative ring coupling reactions.

3791 (DOE/ER/14190–1) **Hydrogen induced C-C, C-N, and C-S bond activation on Pt and Ni surfaces.** Gland, J.L. Michigan Univ., Ann Arbor, MI (United States). Dept. of Chemistry. [1992]. 3p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG02-91ER14190. Order Number DE93004647. Source: OSTI; NTIS; GPO Dep.

The work has focussed on hydrogen induced bond activation in adsorbed organic molecules and intermediates containin C-S and C-N and C-C bonds on Ni(100), Ni(111), and Pt(111) surfaces. Fluorescence Yield Near Edge Spectroscopy (FYNES) above the carbon K edge was used for adsorbed organic reactants and in-situ kinetic studies of bond activation. Results indicate that the activation is enhanced on Ni relative to Pt. Methylthiolate and methylamine adsorbed on Pt(111) were studied.

3792 (DOE/ER/14226–1) **[Charge generation and separation at liquid interfaces]: Technical progress report.** Eisenthal, K.B. Columbia Univ., New York, NY (United States). [1992]. 4p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG02-91ER14226. Order Number DE93003721. Source: OSTI; NTIS; GPO Dep.

The research is divided into 3 parts: (1)Sum Frequency Generation (SFG) and Monolayer Structure. Picosecond lasers are combined by difference frequency mixing in a nonlinear crystal to generate picosecond, tunable IR pulses, which are used to study orientation of C≡N and CD_3 chromosphores (head group and tail) on lipid monolayers $CD_3(CH_2)_{21}CN$ at air/water interface. (2)Femtosecond Dynamics. The femtosecond colliding pulse mode locked laser is being modified to carry out pump-second harmonic (SH) probe studies at liquid interfaces. Picosecond SH knowhow of intermolecular energy transfer, excited state isomerization, and rotational motions at interfaces is now being applied to femtosecond scale. Aromatics adsorbed at air/water interface, generated changes in SH probe signal and their decay back to original value. If the laser is tightly focussed at interface, multiphoton absorption processes occur which destroy the sample; this effect will be exploited. (3)Interface Potential and Acid-Base Equilibria. The interface potential is a key to charge transport; using SHG, we plan to measure the pKa of organic acids at interfaces. In these studies at silica/aqueous interface, the water molecules extending from the interface into the bulk (about 50Å) were strongly polarized by SiO^- charges at the interface. In summary, a new spectroscopic technique is being applied to study of neutral and charged lipid monolayers, interface pKa values, interface potential and orientational structure and vibrational spectroscopy of lipids.

3793 (DOE/ER/45120–T2) **Catalytic oxidation of secondary alcohols.** Augustine, R.L.; Doyle, L.K. Seton Hall Univ., South Orange, NJ (United States). Dept. of Chemistry. [1992]. 5p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG02-84ER45120. Order Number DE93002765. Source: OSTI; NTIS; GPO Dep.

The dioxygen oxidation of alcohols over platinum catalysts has been known for a long time. While of potential importance in synthetic procedures, this process has never found extensive use except in carbohydrate oxidations. Some reasons for this is the fact that this reaction only appears to work well in an aqueous medium in the presence of rather large amounts of a Pt black catalyst. Results obtained here show that supported Pt catalysts can be used to promote this oxidation in organic solvents provided a small amount of water is added to the reaction medium. It was also estabilished that the reaction takes place on the more coordinately unsaturated corner atoms on the Pt surface.

3794 (DOE/ER/45120–T3) **A Frontier Molecular Orbital determination of the active sites on dispersed metal catalysts.** Augustine, R.L.; Lahanas, K.M. Seton Hall Univ., South Orange, NJ (United States). Dept. of Chemistry. [1992]. 11p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG02-84ER45120. Order Number DE93002764. Source: OSTI; NTIS; GPO Dep.

An angular overlap calculation has been used to determine the s, p and d orbital energy levels of the different types of surface sites present on a dispersed metal catalysts. The basis for these calculations is the reported finding that a large number of catalyzed reactions take place on single atom active sites on the metal surface. Thus, these sites can be considered as surface complexes made up of the central active atom surrounded by near-neighbor metal atom "ligands" with localized surface orbitals perturbed only by these "ligands". These "complexes" are based on a twelve coordinate species with the "ligands" attached to the t_{2g} orbitals and the coordinate axes coincident with the direction of the e_g orbitals on the central atom. These data can permit a Frontier Molecular Orbital treatment of specific site activities as long as the surface orbital availability for overlap with adsorbed substrates is considered along with its energy value and symmetry.

3795 (DOE/PC/91287–4) **Supercritical thermodynamcis of sulfur and nitrogen species: Quarterly progress report, April 1, 1992–June 30, 1992.** Eckert, C.A. Georgia Inst. of Tech., Atlanta, GA (United States). School of Chemical Engineering. 1 Oct 1991. 24p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG22-91PC91287. Order Number DE93004922. Source: OSTI; NTIS; GPO Dep.

Significant opportunity exists for the application of supercritical fluid (SCF) technology to coal processing, both for pretreatment of high sulfur coals, as well as liquefaction and treatment of coal liquids. Supercritical fluids are attractive solvents for a variety of coal processing applications because of their unusual solvating and mass transfer properties. Solubility studies have been carried out for a number of model coal and coal liquid compounds, primarily in pure supercritical fluids. We are extending this database of model coal compound equilibria using modern techniques that have the advantage of being much more rapid than traditional techniques. Cosolvent effects on solubility are being investigated over a variety of solvent properties. In addition, specific molecular interactions are being investigated through spectroscopic techniques. The resulting data are being used to develop a chemical-physical equation of state (EOS) model of SCF solution with meaningful parameters. The equation of state will be used to predict solubility behavior, which will permit the design and tailoring of SCF cosolvent systems for specific coal processing applications.

3796 (ETDE-mf–93728981) **North-Rhine Westphalian measuring program 'Chlorinated aromatics - sources and ways of transfer' 1990. Final report.** Ministerium fuer Umwelt, Raumordnung und Landwirtschaft des Landes Nordrhein-Westfalen, Duesseldorf (Germany). Jun 1991 379p. (In German). Order Number DE93728981. Source: OSTI; NTIS (US Sales Only).

The media continuously confront us with a gallery of unrelated pieces of information about dioxins, but there are no consistent findings that would permit the contamination pathway of dioxins to be described - beginning from their individual sources and proceeding via the soil and plants to milk from cows. Separate results for soil, milk or air-borne dust are often difficult to evaluate in the absence of adequate background data and regional differences in the total burden still add to the problems posed here. Even though experts are unanimous that more than 90% of the ingestion of PCDD/F by humans is with the food and approx. one third of this with milk and dairy products, it remains largely obscure how it finds its way into our nutrients. The environmental behaviour of polychlorinated dibenzo-p-dioxines and dibenzo-furans (PCDD/F), their transfer via the food chain and even some of their major sources are still open to discussion. (orig.).

3797 (GKSS–91/E/95) **Enclosive flow cooling: Concept of a new method for simplifying complex molecular spectra.** Bauerecker, S. (Technische Univ. Braunschweig (Germany). Inst. fuer Physikalische und Theoretische Chemie); Cammenga, H.K.; Taucher, F.; Weitkamp, C.; Michaelis, W. GKSS-Forschungszentrum Geesthacht GmbH, Geesthacht-Tesperhude (Germany). 1991. 12p. (CONF-9110439–1: 3. international symposium on monitoring of gaseous pollutants by tunable diode lasers, Freiburg im Breisgau (Germany), 17-18 Oct 1991). Order Number DE93728956. Source: OSTI; NTIS (US Sales Only).

Molecules with more than four atoms generally exhibit relatively complex vibration-rotation spectra at standard conditions. Therefore they are difficult to detect in trace concentrations by absorption spectroscopy. A simplification of the spectrum can be achieved by supercooling the gas. For this purpose a novel cooling scheme is presented. A cooling gas is sucked from the outside through the

porous wall of a sinter metal hollow cylinder towards its axis. A laminar axially symmetrical cooling gas flow develops to which the sample gas is added through a heatable tube at the cylinder front end. The colling gas encloses the sample gas beam, confines it to form a narrow column, cools it down and advects it along the cylinder axis, preventing it from wall adsorption. Optical absorption, e.g., of a laser beam can be observed along the cylinder axis where the sample gas concentration is highest. Because of the relatively low flow velocity on the order of 0.01 to 1 m/s the optical absorption efficiency of the sample gas per unit of gas quantity is several orders of magnitude larger with supersonic jet cooling. In the case of low temperatures and not too low pressure values a given quantity of sample gas may be compressed to 1/100 to 1/1000 of the cell volume of a White cell, thus an enclosive flow cooling cell may produce an optical absorption comparable to a multireflexion cell and so compensate the multireflexion advantage. Smoke experiments in a transparent plexiglas model cell confirm the results of a computer simulation and demonstrate a promising behavior of both the enclosive flow and the sample gas flow. Due to Reynold's similarity law, the flow conditions can be extrapolated to cryogenic temperatures and low pressure values. (orig.).

3798 (IAEA-NAHRES–3, pp. 10.1-10.22) **Solid phase extraction of As(III) from aqueous samples using on-column formation of As(III)-Trispyrrolidinedithiocarbamate.** Eltern, J.T. van (Netherlands Energy Research Foundation (ECN), Petten (Netherlands)); Gruther, G.J.M.; Das, H.A.; Brinkman, U.A.T. International Atomic Energy Agency, Vienna (Austria). Section of Nutritional and Health-Related Environmental Studies. 1990. (CONF-8911339–: 3. research co-ordination meeting on nuclear techniques for toxic elements in foodstuffs, Jakarta (Indonesia), 20 Nov 1989). In *Co-ordinated research programme on nuclear techniques for toxic elements in foodstuffs: Report on the third research co-ordination meeting, Jakarta, Indonesia, 20-24 November 1989.* 184p. Order Number DE93606507. Source: OSTI; NTIS (US Sales Only); INIS.

Two methods are presented for the selective preconcentration of As(III) by using complexation-type stationary phases. These phases are prepared (1) by loading a C18-bonded silica with the cetyltrimethylammonium-pyrrolidinedithiocarbamate (CTA-PDC) ion-pair or (2) by converting a strong anion-exchange (SAX) resin from the quaternary ammonium form into the pyrrolidinedithiocarbamate (PDC) form. When As(III)-containing solutions are passed through such stationary phases, the immobilized PDC yields the non-polar As(III)-trispyrrolidine-dithiocarbamate (As(PDC)) which is retained on the non-loaded back part of the C18 cartridge (methods 1) or on an unloaded C18 cartridge coupled in series with the SAX cartridge (method 2). For both methods parameters influencing the preconcentration have been investigated by using the $^{74}As(III)$-radiotracer; $^{74}As(V)$ was applied to study the selectivity of both methods. A selective preconcentration of As(III) is possible. The retention mechanisms are discussed. 24 refs, 6 figs, 4 tabs.

3799 (IAEA-NAHRES–7, pp. 49-57) **The study of chemical forms of mercury in human hair and other bio-environmental samples.** Stary, J. (Ceske Vysoke Uceni Technicke, Prague (Czechoslovakia). Fakulta Jaderna a Fysikalne Inzenyrska). International Atomic Energy Agency, Vienna (Austria). Section of Nutritional and Health-Related Environmental Studies. 1991. (CONF-9106411–: 1. research co-ordination meeting on assessment of environmental exposure to mercury in selected human populations as studied by nuclear and other techniques, Vienna (Austria), 10-13 Jun 1991). In *Co-ordinated research programme on assessment of environmental exposure to mercury in selected human populations as studied by nuclear and other techniques: Report on the first research co-ordination meeting, Vienna, Austria, 10-13 June 1991.* 105p. Order Number DE93606502. Source: OSTI; NTIS (US Sales Only); INIS.

Compilation and critical evaluation of stability and distribution constants of inorganic mercury(II) and methylmercury complexes with inorganic and organic ligands is planned. The calculation of the optimum conditions (pH, type and concentration of ligand, solvent) for the separation of methylmercury complexes from inorganic mercury(II) complexes using extraction and chromatographic methods are considered. The investigation of the dissolution of hair samples in the presence of labelled methylmercury and inorganic mercury(II) in order to recommend the most versatile procedure avoiding the volatility and destruction of methymercury species. 21 refs.

3800 (IC–92/230) **Conformation analysis of trehalose. Molecular dynamics simulation and molecular mechanics.** Donnamaira, M.C. (International Centre for Theoretical Physics, Trieste (Italy)); Howard, E.I.; Grigera, J.R. International Centre for Theoretical Physics, Trieste (Italy). Sep 1992. 10p. Order Number DE93606577. Source: OSTI; NTIS (US Sales Only); INIS.

Conformational analysis of the disaccharide trehalose is done by molecular dynamics and molecular mechanics. In spite of the different force fields used in each case, comparison between the molecular dynamics trajectories of the torsional angles of glycosidic linkage and energy conformational map shows a good agreement between both methods. By molecular dynamics it is observed a moderate mobility of the glycosidic linkage. The demands of computer time is comparable in both cases. (author). 6 refs, 4 figs.

3801 (INIS-BR–2963) **Addition compounds of perchlorates from yttrium and lanthanides elements with the N,N,N',N'tetramethyl amide of phthalic acid.** Silva, C.P.G. da. Sao Paulo Univ., SP (Brazil). Inst. de Quimica. 1974 90p. (In Portuguese). Order Number DE93606578. Source: OSTI; NTIS (US Sales Only); INIS.

The reaction between lanthanide perchlorates and yttrium with tetra methyl phthalamide (TMPA) was studied, and compounds of the general formula Ln $(C\ 10\ _4)\ _3$. TMPA have been isolated. The compounds were characterized by analysis of their components, infra-red spectra, molar conductances in nitromethane and nitrobenzene, X ray powder patterns and thermal analysis. (author).

3802 (INIS-BR–2964) **Synthesis, properties, structure and thermochemistry of hexa-aqua-tris (N,N-dimethylformamide) lanthanide tri fluoro methane sulfonates.** Araujo Melo, D.M. de. Sao Paulo Univ., SP (Brazil). Inst. de Quimica. 1989 268p. (In Portuguese). Order Number DE93606579. Source: OSTI; NTIS (US Sales Only); INIS.

Addition compounds between several lanthanide salts and dimethylformamide (DMF) have been described in the literature. This thesis reports the synthesis and characterization of the compounds of general composition Ln $(C\ H_3\ SO_3)\ _3$. 3 DMF.6 $H_3\ O$ (Ln = La - Ho) and Ln $(C\ H_3\ SO_3)\ _3$ DMF.6 $H_2\ O$ (Ln = Er - Lu). The structure of the neodymium compound, isomorphous with the series, is also described. The enthalpy variations were determined by solution calorimetry. (author).

3803 (INIS-BR–2999) **Comparative study of the addition compounds between lanthanides methane sulfonates (III) and aromatic amino-oxides as ligands.** Rosario Matos, J. do. Sao Paulo Univ., SP (Brazil). Inst. de Quimica. 1989 215p. (In Portuguese). Order Number DE93606580. Source: OSTI; NTIS (US Sales Only); INIS.

The main goal of this thesis is to further develop the studies on the preparation and characterization of addition compounds obtained from the reaction of lanthanide methane sulfonates and aromatic amino oxides as ligands, pyridine-N-oxides as the picoline-N-oxides (2-pic NO, 3-pic NO and 4-picNO) in order to make a comparative study. (author).

3804 (INIS-BR–3002) **Electrochemical behaviour of the Eu^{3+}/Eu^{2+} system in propionic media studied by cyclic chrono potentiometry.** Brotto, M.E. Sao Paulo Univ., SP (Brazil). Inst. de Quimica. 1989 167p. (In Portuguese). Order Number DE93606582. Source: OSTI; NTIS (US Sales Only); INIS.

The electrochemical behaviour of the Eu^{3+}/Eu^{2+} system in propionic media was studied by means of current reversal chrono potentiometry and cyclic chrono potentiometry. Sodium perchlorate was employed as supporting electrolyte. The experiments were carried out at $(25.0 \pm 0.1)^{0}$ C. The studied variables were the concentration of the electro active species, the composition of the solution and the current density. The cyclic chrono potentiometry results reveal that the charge transfer reaction is followed by the $(H_3\ O)^{+}$ ion assisted irreversible catalytic reaction in which the Eu^{3+} species is regenerated. (author).

3805 (INIS-BR–3055) **Spectroscopic study of some europium (III) and neodymium(III) compounds.** Cunha Felinto, M.C.F. da. Sao Paulo Univ., SP (Brazil). Inst. de Quimica. 1991 222p. (In Portuguese). Order Number DE93606583. Source: OSTI; NTIS (US Sales Only); INIS.

The reaction between hydrated lanthanide (III) thiocyanates and 4-picoline-N-oxide led to the formation of addition compounds with general formula Ln $(NCS)_3.X(4.pic\ NO)$. The characterization of the compounds was made by Ln, C, N, H, elementary analysis, melting point determinations, vibrational spectroscopy (infrared) and electronic spectroscopy in the visible region (Nd^{3+} and Eu^{3+}). In concerning the spectroscopic analysis, 79 compounds of Europium and Neodymium with D_3, C_{3v}, D_{3d} and Oh symmetries were studied in order to calculate the crystal-field parameters, by three different ways: tensorial operator method, equivalent operator method and Wigner's coefficient. A theoretical relationship for the parameters $Y^q{}_k < \gamma^k >$, $B^k{}_q$ and $B^q{}_k$ was established. A study of eleven neodymium isothiocyanate complexes was made in order to establish a nephelauxetic series for the different ligands. A relation considering the oscillator strengths was also found. (author).

3806 (INIS-mf–13365) **Sorption and fixation of biotoxic radionuclides on zeolites for decontamination of the spent fuel elements cooling medium.** Keltos, D. (Atomova Elektraren Bohunice, Jaslovske Bohunice (Czechoslovakia)). Ministerstvo Skolstva, Mladeze a Sportu SR, Bratislava (Czechoslovakia); Komenskeho Univ., Bratislava (Czechoslovakia). Prirodovedecka Fakulta. 1991 18p. (In Czech). Order Number DE93606584. Source: OSTI; NTIS (US Sales Only); INIS.

The batch adsorption of cesium and strontium radionuclides on natural zeolite (clinoptilolite) from Nizny Hrabovec (East Slovakia) was investigated with a view of decontamination of water from the long-time storage pool of spent fuel elements at the A-1 nuclear power plant at Jaslovske Bohunice. The sorption rate of strontium is slightly less than that of cesium but the equilibrium distribution ratio is fairly high for both elements ($D=10^5\ dm^3kg^{-1}$). The adsorption follows the Freundlich-Langmuir isotherm, and batch adsorption of macroamounts of the ions can be optimized semi-empirically. The influence of competing ions (K^+, Na^+, Ca^{2+}, Mg^{2+}) should not prevent efficient sorption of the radionuclides in the course of pool water decontamination. A technological scheme with periodic batch adsorption and recirculation of the filtrate was proposed to minimize the necessary storage volume. Experiments with sorbent fixation in either bitumen or cement matrix indicated the cement matrix to be more suitable as regards radiation stability. The leaching properties of the cement-zeolite composite are satisfactory and meet the standards of the regional storage site at Mochovce. (author) 24 refs.

3807 (IPEN-PUB–355) **TBP 20% diluent/H N O_3/H_2 O liquid-liquid extraction system: equilibrium data normalization of nitric acid, ruthenium and zirconium.** Oliveira, C.A.L.G. de; Araujo, B.F. de. Instituto de Pesquisas Energeticas e Nucleares (IPEN), Sao Paulo, SP (Brazil). Nov 1991. 33p. (In Portuguese). (CONF-8510519–: 26. Brazilian Congress on Chemistry, Fortaleza (Brazil), 6-11 Oct 1985). Order Number DE93606585. Source: OSTI; NTIS (US Sales Only); INIS.

The extraction behavior of nitric acid, nitrosyl ruthenium nitrate and zirconium hydroxide nitrate in the system tri-n-butyl phosphate (TBP) 20% -diluent was studied. The main purpose was to obtain enough data to elaborate process flowsheets for the treatment of irradiated uranium fuels. During the runs, the equilibrium diagrams of nitric acid, ruthenium and zirconium were settled. From the achieved data, the influence of nitric acid, ruthenium, zirconium and nitrate ions concentration in the aqueous phase was checked. Furthermore, the density and the surface tension of the aqueous and organic phases were determined, gathering the interfacial tension after the contact between the phases. (author).

3808 (IS-T–1134) **Characterization of self-assembled carboxylate monolayers and multilayers at copper and silver.** Smith, E.L. Ames Lab., IA (United States). Oct 1992. 148p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-82. Order Number DE93002526. Source: OSTI; NTIS; GPO Dep.

A variety of chemically modified surfaces were constructed by the self-assembly method via chemisorption onto evaporated metal films. Monolayer films, self-assembled from solution, include n-alkanoic acids, $CH_3(CH_2)_nCOOH$, and n-perfluoroalkanoic acids, $CF_3(CF_2)_nCOOH$, on copper, and n-alkanethiolates, $C_H3(CH_2)_nSH$ on copper. Monolayer films were obtained from the gas phase, a newly developed technique, for n-alkanoic acids on silver, and n-alkanethiolates on silver and gold. Multilayer films obtained by self-assembly from the gas phase include n-alkanoic acids at copper and silver and perfluoroacids at copper. Carboxylic acid terminated interfaces were formed by the self-assembly of the bifunctional mercaptoacids, $HS(CH_2)_nCOOH$, via the thiol moiety, at gold. These interfaces were derivatised with copper by deposition of a thin metal overlayer. The monolayer and multilayer films were characterized by optical ellipsometry, contact angle measurements, atomic force and scanning tunneling microscopies, and infrared reflection spectroscopy. Comparisons were made to properties of analogous bulk compounds. These techniques were, used to determine the properties of these films such as composition, orientation, defectiveness, molecular ordering and environment, and hydrophobicity and reactivity.

3809 (IS-T–1628) **The characterization of organic monolayers at gold surfaces using scanning tunneling microscopy and atomic force microscopy correlation with macrostructural properties.** Alves, C.A. Ames Lab., IA (United States). 9 Sep 1992. 193p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-82. Order Number DE93001218. Source: OSTI; NTIS; GPO Dep.

Monolayer films formed by self-assembly of organothiols at epitaxially grown Au(111) films at mica were examined in air using scanning tunneling (STM) and atomic force microscopies (AFM). n-Alkanethiolate monolayers exhibit a hexagonal packing arrangement with nearest-neighbor and next-nearest-neighbor spacings of 0.50 and 0.87 nm. This arrangement is consistent with the $(\sqrt{3} \times \sqrt{3})R30°$ adlayer structure at Au(111). STM reveals the structure of the Au-bound sulfur, while AFM details the structure at the monolayer/air interface, revealing that the order at the Au-S interface is retained up to the monolayer/air interface. The investigation of the self-assembled $CF_3(CF_2)7(CH_2)_2SH$ monolayer at Au(lll) by AFM reveals a (2 x 2) adlayer structure, with nearest-neighbor and next-nearest-neighbor spacings of 0.58 ± 0.02 nm and 1.0 ± 0.02 nm, respectively. This is consistent with the larger van der Waals diameter of the fluorinated chain. Coverage of this fluorinated thiolate monolayer is $(6.3 \pm 0.8) \times 10^{-10}$ mol/cm^2, consistent with the expected 0.25 monolayer coverage of the (2 x 2) adlayer structure at Au(l11). Infrared reflection spectroscopy also confirm this. Upon prolonged exposure to air, the thiolate species is oxidized to elemental sulfur in the forms of cyclooctasulfur (cyclo-S_8) and other allotropes. STM reveals square structures on aged thiolate monolayers. Dimensions of these squares (0.40–0.50 rum per side) are close to those of cyclo-S_8. Electrochemical reductive desorption experiments also reveal a change in the surface species with time, with a second desorption wave.

3810 (LBL–32737) **The strong reactions of Lewis-base noble-metals with vanadium and other acidic transition metals.** Ebbinghaus, B.B. Lawrence Berkeley Lab., CA (United States). May 1991. 262p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC03-76SF00098. Order Number DE93002552. Source: OSTI; NTIS; GPO Dep.

The noble metals often thought of as unreactive solids,react strongly with nearly 40% of the elements in the periodictable: group IIIB-VB transition metals, lanthanides, theactinides, and group IIIA-IVA non-transition metals. These strong reactions arise from increased bonding/electron transfer fromnonbonding electrons d electron pairs on the noble metal tovacant orbitals on V, etc. This effect is a generalized Lewis acid-base interaction. The partial Gibbs energy of V in the noblemetals has been measured as a function of concentration at a temperature near 1000C. Thermodynamics of the intermetallics are determined by ternary oxide equilibria, ternary carbide equilibria, and the high-temperature galvanic cell technique. These experimental methods use equilibrated solid composite mixtures in which grains of V oxides or of V carbides are interspersed with grains of V-NM(noble-metal) alloys. In equilibrium the activity of V in the oxide or the carbide equals the activity in the alloy. Consequently, the thermodynamics available in

the literature for the V oxides and V carbides are reviewed. Test runs on the galvanic cell were attempted. The V oxide electrode reacts with CaF_2, ThO_2, YDT($0.85ThO_2$-$0.15YO_{1.5}$), and LDT($0.85ThO_2$- $0.15LaO_{1.5}$) to interfere with the measured data observed toward the beginning of a galvanic cell experiment are the most accurate. The interaction of vanadium at infinite dilution in the noble-metals was determined.

3811 (LBL–32841) **Electronic excited states as a probe of surface adsorbate structure and dynamics in liquid xenon.** Peterson, E.S. Lawrence Berkeley Lab., CA (United States). Aug 1992. 152p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC03-76SF00098. Order Number DE93002550. Source: OSTI; NTIS; GPO Dep.

A combination of second harmonic generation (SHG) and a simple dipole-dipole interaction model is presented as a new technique for determining adsorbate geometries on surfaces. The polarization dependence of SHG is used to define possible geometries of the adsorbate about the surface normal. Absorption band shifts using geometry constraints imposed by SHG data are derived for a dimer constructed from two arbitrarily placed monomers on the surface using the dipole-dipole interaction potential. These formulae can be used to determine the orientation of the two monomers relative to each other. A simplified version of this formalism is used to interpret absorption band shifts for rhodamine B adsorbed on fused silica. A brief history of the exciton is given with particular detail to Xe. Data are presented for transient absorption at RT in liquid xenon on the picosecond time scale. These are observations of both tunneling through the barrier that separates the free and trapped exciton states and the subsequent trapping of the exciton. In high densities both of these processes are found to occur within 2 to 6 picoseconds in agreement with theories of Kmiecik and Schreiber and of Martin. A threshold density is observed that separates relaxation via single binary collisions and relaxation that proceeds via Martin's resonant energy transfer hopping mechanism.

3812 (LBL–32853) **The effect of rhenium, sulfur and alumina on the conversion of hydrocarbons over platinum single crystals: Surface science and catalytic studies.** Kim, C. Lawrence Berkeley Lab., CA (United States). Apr 1992. 138p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC03-76SF00098. Order Number DE93002557. Source: OSTI; NTIS; GPO Dep.

Conversion reactions of hydrocarbons over Pt-Re model catalyst surfaces modified by sulfur and alumina have been studied. A plasma deposition source has been developed to deposit Pt, Re, and Al on metal substrates variable coverage in ultrahigh vacuum without excessive heating. Conversion of n-hexane was performed over the Re-covered Pt and Pt-covered Re surfaces. The presence of the second metal increased hydrogenolysis activity of both Pt-Re surfaces. Addition of sulfur on the model Catalyst surfaces suppressed hydrogenolysis activity and increased the cyclization rate of n-hexane to methylcyclopentane over Pt-Re surfaces. Sulfiding also increased the dehydrogenation rate of cyclohexane to benzene Over Pt-Re surfaces. It has been proposed that the PtRe bimetallic catalysts show unique properties when combined with sulfur, and electronic interactions exist between platinum, rhenium and sulfur. Decomposition of hydrocarbons on the sulfur-covered Pt-Re surfaces supported that argument. For the conversion of 1-butene over the planar Pt/AlO_x, the addition of Pt increased the selectivity of hydrogenation over isomerization.

3813 (LBL–32892) **The synthesis and structural characterization of novel transition metal fluorides.** Casteel, W.J. Jr. Lawrence Berkeley Lab., CA (United States). Sep 1992. 142p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC03-76SF00098. Order Number DE93002551. Source: OSTI; NTIS; GPO Dep.

High purity KMF_6 and K_2MF_6 salts (M = Mo,Re, Ru, Os, Ir, Pt) are obtained from reduction hexafluorides. A rhombohedral unit cell is observed for $KReF_6$. Fluoride ion capture by Lewis acids from the hexafluorometallate (IV) salts affords high purity tetrafluorides for M = Mo, Re, Ru, Os, and Pd. The structure of RuF_4 is determined from X-ray synchrotron and neutron powder data. Unit cells based on theorthorhombic PdF_4 type cell are derived from X-ray powder data for ReF_4 and OsF_4. Fluoride ion capture from $KAgF_4$ provides the thermally unstable trifluoride as a bright, red, diamagnetic solid. The structure solution of AgF_3 and redetermination of the AuF_3 structure from X-ray synchrotron and neutron powder data demonstrate that the two are isostnictural. Thermal decomposition product of AgF_3 is the mixed valence compound $Ag^{II}Ag_2^{III}F_8$. Several new salts containing the $(Ag - F)_n^{n+}$ chain cation are prepared. The first linear $(Ag - F)_n^{n+}$ chain is observed in $AgF^+BF_4^-$ which crystallizes in a tetragonal unit. $AgFAuF_4$ has a triclinic unit cell and is isostructural with $CuFAuF_4$. $AgFAuF_6$ has an orthorhombic unit cell and appears to be isostructural with $AgFAsF_6$. A second mixed valence silver fluoride, $Ag^{II}Ag^{III}F_5$, is prepared, which magnetic measurements indicate is probably an AgF^+ salt. Magnetic data for all of the AgF^+ salts exhibit low magnitude, temperature independent paramagnetism characteristic of metallic systems. Cationic AG(II) in acidic AHF solutions is a powerful oxidizer, capable of oxidizing Xe to Xe(II) and O_2 to O_2^+. Reactions with C_6F_6 and C_3F_6 suggest an electron capture mechanism for cationic AG(II) oxidations.

3814 **Actinide halide complexes.** Avens, L.R.; Zwick, B.D.; Sattelberger, A.P.; Clark, D.L.; Watkin, J.G. To Dept. of Energy. 7 Feb 1991. USAA patent application 7-651,86. 14p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. Order Number DE93001995. Source: OSTI; NTIS; GPO Dep.

A compound of the formula MX_nL_m wherein M = Th, Pu, Np,or Am thorium, X = a halide atom, n = 3 or 4, L is a coordinating ligand selected from the group consisting of aprotic Lewis bases having an oxygen-, nitrogen-, sulfur-, or phosphorus-donor, and m is 3 or 4 for monodentate ligands or is 2 for bidentate ligands, where n + m = 7 or 8 for monodentate ligands or 5 or 6 for bidentate ligands, a compound of the formula MX_n wherein M, X, and n are as previously defined, and a process of preparing such actinide metal compounds including admixing the actinide metal in an aprotic Lewis base as a coordinating solvent in the presence of a halogen-containing oxidant, are provided.

3815 (PNL-SA–21119) **Effects of delocalization on intrinsic barriers for H-atom transfer: Implications for the radical hydrogen transfer reaction.** Camaioni, D.M.; Autrey, S.T.; Ferris, K.F.; Franz, J.A. Pacific Northwest Lab., Richland, WA (United States). Aug 1992. 5p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. (CONF-9208170–1: 6. organic free radicals symposium, Noordwijkerhout (Netherlands), 23-28 Aug 1992). Order Number DE93001565. Source: OSTI; NTIS; GPO Dep.

PM3 calculations of transition states (TS) for both normal H-atom transfer and radical hydrogen transfer (RHT) reactions of a a wide-variety of hydrocarbon structures have enabled development of quantitative structure-reactivity relationships. Results indicate that activation barriers for RHT reactions are large enough that thermoneutral and endothermic reactions should not compete with alternative multistep pathways.

3816 (SAND–92-0263C) **Solar photocatalysis for the treatment of water containing toxic metals.** Prairie, M.R.; Evans, L.R.; Stange, B.M.; Wagaman, M.W. Sandia National Labs., Albuquerque, NM (United States). [1992]. 11p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-76DP00789. (CONF-920938–2: 6. international symposium on solar thermal concentrating technologies, Mojacar (Spain), 25 Sep - 2 oct 1992). Order Number DE93002278. Source: OSTI; NTIS; GPO Dep.

This paper describes laboratory work that investigates the applicability of solar photocatalysis to the treatment of water contaminated with heavy metals and organics. It was found that Ag(I), Cr(VI), Hg(II), and Pt(II) are easily treated while CD(II), Cu(II), and Ni(II) are not. The importance of the entire photocatalytic redox cycle is demonstrated by showing that the rates of oxidation (of organics) and reduction (of metals) are intrinsically interrelated. As a result, very efficient photocatalytic decontamination can be realized by applying the technology to water contaminated with the right mixtures of organic compounds and reducible, toxic metals. It is also shown that photocatalysis is effective for treating the compound phenylmercuric chloride, suggesting that solar detoxification may find a niche for handling hard-to-treat organometallic

complexes. Data are presented showing how photoefficiencies decrease as light intensity increases in the range of 0 to 20 suns UV. This result suggests that one-sun systems are more efficient than those using concentrated solar radiation.

3817 (SER/CDM–30) **Thermodynamical study of nitric dissolution of uranium oxide.** Mellah, A. (Centre de Developpement des Materiaux, Algiers (Algeria). Lab. d'Analyse); Chegrouche, S.; Challal-Messad, Dj.; Mebarki, Dj. Secretariat d'Etat a la Recherche, Algiers (Algeria); Centre de Developpement des Materiaux, Algiers (Algeria). Sep 1992. 8p. (In French). Order Number DE93606586. Source: OSTI; NTIS (US Sales Only); INIS.

The purpose of this study is to determine the predominating reaction that takes place during the nitric dissolution of uranium oxide by means of the themkine-chvartzman based on the calculation of the reaction free energies.

3818 (SER/LSO-DC–50) **Science and technology of the rare earth elements.** Azzouz, Abdelkrim (Centre de Developpement des Materiaux, Algiers (Algeria). Lab. de Synthese Organique); Chegrouche, Salah; Telmoune, Sid-Ali; Layachi, Lazhar. Secretariat d'Etat a la Recherche, Algiers (Algeria); Centre de Developpement des Materiaux, Algiers (Algeria). Jul 1992. 16p. (In French). Order Number DE93606587. Source: OSTI; NTIS (US Sales Only); INIS.

The present work studies the chemical physics properties, the different methods of analysis (neutron activation, emission spectrometry, chromatography), and the techniques of separation of rare earth (electrodeposition, thermic decomposition, salts distillation and ions exchange).

3819 (UCRL-JC–110655-Rev.1) **The adsorption of C_{60} and the Co-adsorption of C_{60} and H_2O on α-Al_2O_3 (1$\bar{1}$02)-(2×1).** Hamza, A.V.; Balooch, M. Lawrence Livermore National Lab., CA (United States). Aug 1992. 16p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. (CONF-9206304–1-Rev.1: 15. surface and interface research meeting, Berkeley, CA (United States), 19 Jun 1992). Order Number DE93001327. Source: OSTI; NTIS; GPO Dep.

Binding of submonolayer coverages of C_{60} to α-Al_2O_3 (1102)-(2 × 1) is observed by temperature-programmed desorption with peak temperatures for desorption between 430 and 460 K. Estimated first-order activation energy and preexponential factor are 25 ± 6 kcal/mol and 6.3 × 10^{11} s^{-1} Multilayer desorption of C_{60} behaves similarly to that observed previously from the (0001) surface. Exposure of $C_{60}$to a water predosed surface did not displace the adsorbed surface hydroxyls. Concomitant desorption of C_{60} and water is observed from a water predosed surface subsequently exposed to C_{60} multilayers. Whereas, water post-dosed onto a C_{60}-covered surface has a sticking probability less than 4 × 10^{-3}.

3820 (WINCO–1105) **Verification of thermodynamic codes REACT and EQUILIB for the study of non-aqueous inorganic systems.** Kessinger, G.F. Westinghouse Idaho Nuclear Co., Inc., Idaho Falls, ID (United States). Sep 1992. 44p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC07-84ID12435. Order Number DE93001403. Source: OSTI; NTIS; INIS; GPO Dep.

This report is a description of studies performed to evaluate the performance of the Facility for the Analysis of Chemical Thermodynamics (F*A*C*T) EQUILIB and REACT computational package programs for applications involving the study of the chemical equilibria non-aqueous inorganic systems. The REACT code was verified by comparing code results to the results of hand calculations; the EQUILIB code was verified by comparing code results to the results of hand calculations, published phase diagrams, and the results of the F*A*C*T REACT code (which was verified prior to its use to verify the EQUILIB code). The results of the verification tests identified two failures of the REACT code to compute reliable results and identifies the conditions when the quality of the computed results are affected. The verification tests for the EQUILIB code identified no failures of the code to produce reliable results.

4004 Electrochemistry

Refer also to citation(s) 3810

3821 (DOE/ER/45461–1) **Fundamental studies of passivity and passivity breakdown.** Macdonald, D.D. Pennsylvania State Univ., University Park, PA (United States). 20 Apr 1992. 31p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG02-91ER45461. Order Number DE93002747. Source: OSTI; NTIS; GPO Dep.

Effects of minor alloying elements on passivity breakdown and of photo effects on the properties of passive films are under study, and electrochemical and photoelectrochemical techniques are being used to explore transport and kinetic properties of vacancies and charge carriers in films and at metal/film and film/solution interfaces. Point defect and solute/vacancy interaction models are being developed to account for distributions in critical voltage and induction time for passivity breakdown by incorporating thermodynamics of absorption of halide ions into surface oxygen vacancies, by invoking different mechanisms for cation vacancy generation at film/solution interface, by extending the models to passive films on metal substrates having variable cation oxidation states, and by deriving rate laws for growth of passive films in response to an imposed voltage perturbation.

3822 (LBL–32417) **Structural transformation of nickel hydroxide films during anodic oxidation.** Crocker, R.W.; Muller, R.H. Lawrence Berkeley Lab., CA (United States). May 1992. 8p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC03-76SF00098. (CONF-921036–9: 182. meeting of the Electrochemical Society, Toronto (Canada), 11-16 Oct 1992). Order Number DE93001863. Source: OSTI; NTIS; GPO Dep.

Investigation of anodically formed nickel hydroxide/oxy-hydroxide electrodes has determined that the phase boundary between the materials evolves via a nodular structure within the electrode film during the anodic oxidation reaction. This nodular growth mechanism is caused by the disparity in conductivity between the phases. Unconverted material is trapped within the film by an overlayer which forms across the film/electrolyte interface. Scanning tunneling microscopy and spectroscopic ellipsometry experiments support this structure model.

3823 **High frequency reference electrode.** Kronberg, J.W. To Dept. of Energy. 5 Mar 1991. USAA patent application 7-665,64. 16p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC09-89SR18035. Order Number DE93002019. Source: OSTI; NTIS; GPO Dep.

A high frequency reference electrode for electrochemical experiments comprises a mercury-calomel or silver-silver chloride reference electrode with a layer of platinum around it and a layer of a chemically and electrically resistant material such as TEFLON around the platinum covering all but a small ring or "halo" at the tip of the reference electrode, adjacent to the active portion of the reference electrode. The voltage output of the platinum layer, which serves as a redox electrode, and that of the reference electrode are coupled by a capacitor or a set of capacitors and the coupled output transmitted to a standard laboratory potentiostat. The platinum may be applied by thermal decomposition to the surface of the reference electrode. The electrode provides superior high-frequency response over conventional electrodes.

4005 Photochemistry

Refer also to citation(s) 2928, 3783, 3888, 4668

3824 (DOE/ER/13227–T5) **[Laser flash photolysis, EPR and Raman studies of liquids at elevated pressures].** Eyring, E.M. Utah Univ., Salt Lake City, UT (United States). Dept. of Chemistry. [1992]. 28p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG02-84ER13227. Order Number DE93001788. Source: OSTI; NTIS; GPO Dep.

The proposed research will solve a number of analytical chemical problems in solutions with measurement techniques that benefit from the use of elevated hydrostatic pressures: stopped-flow spectrophotometry (Gd^{3+} + L(ligand), $[RuL_5H_2O]^{2+}$, laser flash photolysis of $Mo(CO)_6$ + L, flash photolysis of binuclear metalloproteins), EPR spectroscopy (Gd^{3+} ion-exchanged into ETS-10 and ETAS-10 molecular sieves), laser flash photolysis kinetic studies of

$Mo(CO)_6$-2,2'-bipyridine, and electrochemical studies of metalloporphyrins using resonance Raman spectroscopy.

3825 (DOE/ER/45056–10) **Energy transfer and non-linear optical properties at near ultraviolet wavelengths: Rare earth 4f → 5d transitions in crystals and glasses: Final report, June 1, 1984–May 31, 1992.** Hamilton, D.S. Connecticut Univ., Storrs, CT (United States). Aug 1992. 59p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG02-84ER45056. Order Number DE93002133. Source: OSTI; NTIS; GPO Dep.

The following topics were studied: two-photon transitions from 4f ground state to 5d excited states in Ce^{3+}:CaF_2; optical absorption and photoionization measurements from excited state of Ce^{3+}:$Y_3Al_5O_{12}$; excited state photoionization of Ce^{3+} ions in Ce_{3+}:CaF_2; optical gain and loss studies in Ce^{3+}:$LiYF_4$; Gd →Cr energy transfer in Cr^{3+}:GSGG, Cr^{3+}:GSAG and Cr^{3+}:GGG crystals; nonradiative relaxation in Ce^{3+} doped crystals and glasses; and grating formation in impurity doped crystals.

3826 (SERI/CP–236-4396, pp. 3-4) **Size quantization effects in semiconductor and metal colloids.** Henglein, A. (Hahn-Meitner-Institut Berlin GmbH (Germany)). Solar Energy Research Inst., Golden, CO (United States). 1991. (CONF-9106213–Absts.: 15. Department of Energy (DOE) solar photochemistry research conference, Snowmass, CO (United States), 2-6 Jun 1991). In *Fifteenth DOE solar photochemistry research conference.* 165p. Order Number DE91002165. Source: OSTI; NTIS.

Small semiconductor particles in colloidal solution have often been used as sensitizers and catalysts of photochemical reactions, and small metal particles in solution have been used as electron pools and as catalysts on the surface of semiconductors. In order to understand the function of these catalysts in detail, the author has studied their physicochemical properties in the size range where the transition from semiconducting or metallic properties to molecular properties takes place. In quantized particles, the absorption threshold and the fluorescence band are blue-shifted. Size quantization is present in many materials, including metal colloids, which show the same changes in absorption and fluorescence with varying particle size as semiconductor particles.

3827 (SERI/CP–236-4396, pp. 7-11) **Photosensitization of large bandgap semiconductor colloids. Short bandgap semiconductor colloids and squaraine dyes as sensitizers.** Kamat, P.V. (Univ. of Notre Dame, IN (United States)). Solar Energy Research Inst., Golden, CO (United States). [1991]. (CONF-9106213–Absts.: 15. Department of Energy (DOE) solar photochemistry research conference, Snowmass, CO (United States), 2-6 Jun 1991). In *Fifteenth DOE solar photochemistry research conference.* 165p. Order Number DE91002165. Source: OSTI; NTIS.

Modification of a large bandgap semiconductor surface with a suitable photoactive species such as a dye molecule, can extend its absorptive range and thus carry out photoelectrochemical reactions under visible light irradiation. The author has used zinc oxide colloids and coupled semiconductor systems of zinc oxide and titanium oxide colloids coupled with cadmium sulfide semiconductors, as well as dye sensitization using squaraine dyes to study the mechanistic and kinetic details of the various charge transfer events which influence photosensitization, and to develop new methods for achieving better charge separation.

3828 (SERI/CP–236-4396, pp. 17-19) **Photochemically induced charge separation and hydrogen evolution in microporous solids.** Mallouk, T.E. (Univ. of Texas, Austin (United States)); Kim, Yeong, II; Yonemoto, E.H.; Rong, Daiting. Solar Energy Research Inst., Golden, CO (United States). [1991]. (CONF-9106213–Absts.: 15. Department of Energy (DOE) solar photochemistry research conference, Snowmass, CO (United States), 2-6 Jun 1991). In *Fifteenth DOE solar photochemistry research conference.* 165p. Order Number DE91002165. Source: OSTI; NTIS.

Microporous inorganic solids, such as zeolites, clays and layered oxide semiconductors, offer several advantages as organizing media for molecular electron transport assemblies. The authors are studying the kinetics of electron transfer reactions in these assemblies using transient spectroscopic and electrochemical methods. The goals of this work are to understand the factors which govern the efficiency of photochemically induced charge separation, and ultimately to prepare non-sacrificial photochemical systems which produce energetic chemical such as hydrogen.

3829 (SERI/CP–236-4396, pp. 21-22) **Photocarrier relaxation in cadmium chalcogenides.** Waldeck, D.H. (Univ. of Pittsburgh, PA (United States)). Solar Energy Research Inst., Golden, CO (United States). [1991]. (CONF-9106213–Absts.: 15. Department of Energy (DOE) solar photochemistry research conference, Snowmass, CO (United States), 2-6 Jun 1991). In *Fifteenth DOE solar photochemistry research conference.* 165p. Order Number DE91002165. Source: OSTI; NTIS.

The efficiency of photoinduced charge transfer at the surface of a semiconductor electrode is strongly influenced by nonradiative relaxation in the semiconductor material. These relaxation processes can mediate or compete with charge transfer. The focus of the author's recent studies is the elucidation of the charge carrier dynamics and the mechanism of charge carrier relaxation. In these studies the time resolved emission from the bandgap of the semiconductor (either n-CdS or n-CdSe) is used to monitor the time evolution of the carrier population. In conjunction with these time resolved studies various analytical and electrochemical methods are used to characterize the electrode and its surface.

3830 (SERI/CP–236-4396, pp. 23-25) **Quantization effects in photoelectrodes comprised of quantum well structures.** Nozik, A.J. (Solar Energy Research Inst., Golden, CO (United States)); Levi, D.H.; Szmyd, D.M.; Thacker, B.R.; Heben, M.J.; Turner, J.A. Solar Energy Research Inst., Golden, CO (United States). [1991]. (CONF-9106213–Absts.: 15. Department of Energy (DOE) solar photochemistry research conference, Snowmass, CO (United States), 2-6 Jun 1991). In *Fifteenth DOE solar photochemistry research conference.* 165p. Order Number DE91002165. Source: OSTI; NTIS.

A detailed investigation of both time-integrated and time-resolved photoluminescence (PL) spectroscopy in the femtosecond and picosecond/nanosecond time regimes has been completed to resolve an important controversy concerning the relative hot electron cooling rates in bulk GaAs semiconductors compared to GaAs quantum wells. The experiments clearly showed that the hot electron cooling rates in GaAs quantum wells were much slower than in bulk material when the photogenerated carrier density is above about 2×10^{18} cm^{-3}; this difference in hot carrier cooling rates becomes greater with increasing photocarrier density. This is explained by a 'hot phonon bottleneck' process.

3831 (SERI/CP–236-4396, pp. 29-31) **Chemistry with red and near infrared light.** Frei, H. (Lawrence Berkeley Lab., CA (United States)). Solar Energy Research Inst., Golden, CO (United States). [1991]. (CONF-9106213–Absts.: 15. Department of Energy (DOE) solar photochemistry research conference, Snowmass, CO (United States), 2-6 Jun 1991). In *Fifteenth DOE solar photochemistry research conference.* 165p. Order Number DE91002165. Source: OSTI; NTIS.

Search for chemistry with long wavelength photons, especially those in the near infrared, is motivated by a need to exploit these most abundant solar photons for synthesis and to accomplish their storage and conversion into useful energy. Control and specificity are crucial aspects of the efficient use of photon energy. Over the past two years, the authors has explored low energy paths of reactions in two different environments, namely cryogenic solid matrices and room temperature solutions. Emphasis on experiments in these areas is on elucidation of the mechanisms and kinetics of the redox reactions.

3832 (SERI/CP–236-4396, pp. 33-35) **Matrix ESR studies of organic radical cations and their thermal and photoinduced rearrangements.** Williams, F. (Univ. of Tennessee, Knoxville (United States)). Solar Energy Research Inst., Golden, CO (United States). [1991]. (CONF-9106213–Absts.: 15. Department of Energy (DOE) solar photochemistry research conference, Snowmass, CO

(United States), 2-6 Jun 1991). In *Fifteenth DOE solar photochemistry research conference.* 165p. Order Number DE91002165. Source: OSTI; NTIS.

As the ubiquitous primary products of one-electron oxidation, radical cations play a key role in the chemistry of photosensitized electron transfer (PET) and redox reactions of organic substrates carried out in liquid media at ambient temperatures. Azoalkanes have been the subject of numerous studies as suitable electron donors in PET reactions, with the structure of the radical cation of 2,3-diazabicyclo[2.2.2]oct-2-ene having been recently elucidated. The author has subsequently conducted experiments utilizing electron spin resonance (ESR) to examine the reactivity of this species.

3833 (SERI/CP–236-4396, pp. 37-39) **Photoinduced electron transfer processes in homogeneous and microheterogeneous solutions.** Whitten, D.G. (Univ. of Rochester, NY (United States)); Ci, Xiaohong; Kellett, M.A.; Haugen, C.; Leon, J.; Gan, Hong; Bergmark, W. Solar Energy Research Inst., Golden, CO (United States). [1991]. (CONF-9106213–Absts.: 15. Department of Energy (DOE) solar photochemistry research conference, Snowmass, CO (United States), 2-6 Jun 1991). In *Fifteenth DOE solar photochemistry research conference.* 165p. Order Number DE91002165. Source: OSTI; NTIS.

The authors have examined a variety of photoreactions which are initiated by single electron transfer (SET) quenching of excited states either intra- or intermolecularly. Their most recent work has involved investigations of efficient fragmentation through C-C bond cleavage in electron donors activated by set quenching of excited acceptors and of reactions in which photoinduced two-electron redox chemistry can lead to metastable products which store energy. The present work is aimed at elucidating the mechanisms for these reactions.

3834 (SERI/CP–236-4396, pp. 43-45) **Experimental and computational studies of polar solvation.** Maroncelli, M. (Pennsylvania State Univ., University Park (United States)). Solar Energy Research Inst., Golden, CO (United States). [1991]. (CONF-9106213–Absts.: 15. Department of Energy (DOE) solar photochemistry research conference, Snowmass, CO (United States), 2-6 Jun 1991). In *Fifteenth DOE solar photochemistry research conference.* 165p. Order Number DE91002165. Source: OSTI; NTIS.

Electron and proton transfer reactions are ubiquitous in chemistry and biology and play a key role in virtually all energy conversion schemes. Such charge transfer reactions are most often carried out in aqueous solution or in other similarly polar media, where the electrostatic coupling to the surrounding environment is strong enough to profoundly influence reaction rates. The goal of the author's research is to gain a better understanding of the fundamental aspects of this solvent-reaction coupling and how it impacts solution phase charge transfer dynamics.

3835 (SERI/CP–236-4396, pp. 47-50) **The influence of diffusion and photoinduced electron transfer and electronic excitation transport in clustered chromophore systems.** Fayer, M.D. (Stanford Univ., CA (United States)). Solar Energy Research Inst., Golden, CO (United States). [1991]. (CONF-9106213–Absts.: 15. Department of Energy (DOE) solar photochemistry research conference, Snowmass, CO (United States), 2-6 Jun 1991). In *Fifteenth DOE solar photochemistry research conference.* 165p. Order Number DE91002165. Source: OSTI; NTIS.

The lifetime of photo-generated ions in solution depends on the forward and back electron transfer parameters, the concentrations of donors and acceptors, and on the diffusion characteristics of the donor and acceptor (viscosity of the solvent). The previously derived theory of photoinduced electron transfer and back transfer in solid solutions has been extended to include diffusion of the molecules. The problem is treated for any diffusion constant, any acceptor concentration, and any combination of forward and back electron transfer parameters. The theory includes both donor-donor and donor-acceptor excluded volume and the appropriate donor-acceptor reflecting boundary condition. Experimental results using rubrene as the donor and duroquinone as the acceptor have compared very well with theoretical predictions. Experiments have also been conducted on excitation transport in chromophore clusters and on inhomogeneous broadening in liquids.

3836 (SERI/CP–236-4396, pp. 51-52) **Theoretical studies of electron transfer in complex media.** Chandler, D. (Univ. of California, Berkeley (United States)). Solar Energy Research Inst., Golden, CO (United States). [1991]. (CONF-9106213–Absts.: 15. Department of Energy (DOE) solar photochemistry research conference, Snowmass, CO (United States), 2-6 Jun 1991). In *Fifteenth DOE solar photochemistry research conference.* 165p. Order Number DE91002165. Source: OSTI; NTIS.

In the authors theoretical studies of electron transfer in complex media, the broad issues he is concerned with are: (1) the structure and energetics of the transition states leading to charge transfer in condensed noncrystalline materials, (2) the structure and energetics of stable charge localized states in such systems, (3) the pathways between the stable states and the fleeting or imaginary transition states. The theoretical techniques he brings to bear on these issues include analytical calculations as well as molecular modeling, classical and quantum Monte Carlo and molecular dynamics. The objective of his work is the quantitative understanding of specific electron transfer systems found in nature, and a sufficient qualitative understanding of such processes to provide guidance for future experimental work. His previous work on this subject has centered on the ferrous-ferric exchange system.

3837 (SERI/CP–236-4396, pp. 53-55) **The role of electronic structure in electron transfer kinetics and related phenomena.** Newton, M.D. (Brookhaven National Lab., Upton, NY (United States)). Solar Energy Research Inst., Golden, CO (United States). [1991]. (CONF-9106213–Absts.: 15. Department of Energy (DOE) solar photochemistry research conference, Snowmass, CO (United States), 2-6 Jun 1991). In *Fifteenth DOE solar photochemistry research conference.* 165p. Order Number DE91002165. Source: OSTI; NTIS.

Electron transfer reactions constitute an important class of transformations which span all branches of chemistry, and which play an important role in the storage and transformation of chemical energy. In this research program, the mechanisms of electron transfer reactions and related phenomena are analyzed theoretically, with particular emphasis on the role of electronic structure and the manner in which its influence may be affected by energetic and dynamical properties of the medium in which the reaction occurs.

3838 (SERI/CP–236-4396, pp. 59-64) **Efficient photoinduced charge separation and storage in the solid state: Rates, energetics, and spin-polarization.** Wasielewski, M.R. (Argonne National Lab., IL (United States)); Gaines, G.L.; O'Neil, M.P.; Svec, W.A.; Niemczyk, M.P. Solar Energy Research Inst., Golden, CO (United States). [1991]. (CONF-9106213–Absts.: 15. Department of Energy (DOE) solar photochemistry research conference, Snowmass, CO (United States), 2-6 Jun 1991). In *Fifteenth DOE solar photochemistry research conference.* 165p. Order Number DE91002165. Source: OSTI; NTIS.

Rates of photoinduced charge separation proceeding from the lowest excited singlet state in 14 fixed-distance porphyrin-triptycene-acceptor molecules were measured in 2-methyltetrahydrofuran glass at 77 K. Data from these reactions has been used to design an efficient donor-acceptor molecule which produces an ion pair in 67% yield in the solid state. EPR studies of the kinetics of this reaction have been conducted. Molecules of this type are being used as prototype systems for developing the basic concepts necessary to produce efficient solar energy conversion and storage devices.

3839 (SERI/CP–236-4396, pp. 65-68) **Photoinitiated electron transfer in synthetic tetrads and pentads.** Gust, D. (Arizona State Univ., Tempe (United States)); Moore, T.A.; Moore, A.L. Solar Energy Research Inst., Golden, CO (United States). [1991]. (CONF-9106213–Absts.: 15. Department of Energy (DOE) solar photochemistry research conference, Snowmass, CO (United States), 2-6 Jun 1991). In *Fifteenth DOE solar photochemistry research conference.* 165p. Order Number DE91002165. Source: OSTI; NTIS.

The authors approach to the study of photosynthesis is to prepare and investigate artificial photosynthetic systems. They are concerned with mimicking the multistep electron transfer strategy of natural reaction centers whereby light energy is used to create long-lived, energetic charge separated states in high quantum

yield. Several multicomponent molecular devices which use a multistep electron transfer strategy similar to that of photosynthetic organisms have been synthesized and studied spectroscopically. These molecules consist of porphyrin moieties complexed with zinc, carotenoid polyenes, and diquinones.

3840 (SERI/CP–236-4396, pp. 69-72) **Charge transfer pathways in reversible model electron transfer systems.** Bowman, M.K. (Argonne National Lab., IL (United States)); Norris, J.R.; Levanon, H. Solar Energy Research Inst., Golden, CO (United States). [1991]. (CONF-9106213–Absts.: 15. Department of Energy (DOE) solar photochemistry research conference, Snowmass, CO (United States), 2-6 Jun 1991). In *Fifteenth DOE solar photochemistry research conference.* 165p. Order Number DE91002165. Source: OSTI; NTIS.

Light driven electron transfer reactions in solution generally produce electron spin polarized free radicals as products. This work employs the resulting chemically-induced electron spin polarization as a probe of the mechanisms involved in the light-driven electron transfer step and in the charge-recombination back reaction between the photoproducts. The Fourier Transform Electron Paramagnetic Resonance (FT-EPR) method provides qualitative information about the identity of the species involved, as well as quantitative information about the rates of the individual reaction involved. The individual reaction steps transfer a 'spin memory' to their products, either as a population difference between different spin states or as a phase difference between the wavefunctions of states.

3841 (SERI/CP–236-4396, pp. 73-74) **Photoexcited charge pair escape and recombination.** Braun, C.L. (Dartmouth College, Hanover, NH (United States)); Brown, S.S.; Hou, F.; Smirnov, S.N. Solar Energy Research Inst., Golden, CO (United States). [1991]. (CONF-9106213–Absts.: 15. Department of Energy (DOE) solar photochemistry research conference, Snowmass, CO (United States), 2-6 Jun 1991). In *Fifteenth DOE solar photochemistry research conference.* 165p. Order Number DE91002165. Source: OSTI; NTIS.

Photoionization of molecules in hydrocarbon liquids is increasingly well understood. The photoelectron is believed to thermalize on the subpicosecond time scale and then execute a random walk with respect to its parent cation. Both steady state and time-resolved experiments find initial radii of 2-15 nm for such geminate charge pairs, depending on the liquid and photon energy which are used. The authors present transient absorption studies are able to characterize accurately the initial radius distribution and to confirm that the time dependence of the recombination or escape of such pairs is governed by a diffusion equation. Photoionization in organic solids comprised of electron donor and acceptor molecules is poorly understood despite the importance of technology (e.g. electrophotography) of such systems. They are studying the formation of free holes and electrons in systems where the lowest excited state of the system is of charge transfer (CT) character. Fast (nsec) current risetime measurements following pulsed laser excitation of the sample indicate that the free carriers originate from unrelaxed or Franck-Condon CT states. Concern that the fast currents might be arising from rotation of the CT axis in the applied electric field, led to the detection of such currents in a liquid solution containing a solute with a large excited state dipole moment.

3842 (SERI/CP–236-4396, pp. 77-79) **Electrochemical EPR, ENDOR, and molecular orbital study of carotenoids and carotenoid cation radicals.** Kispert, L.D. (Univ. of Alabama, Tuscaloosa (United States)); Khaled, M.; Piekarasady, L.; Chen, X. Solar Energy Research Inst., Golden, CO (United States). [1991]. (CONF-9106213–Absts.: 15. Department of Energy (DOE) solar photochemistry research conference, Snowmass, CO (United States), 2-6 Jun 1991). In *Fifteenth DOE solar photochemistry research conference.* 165p. Order Number DE91002165. Source: OSTI; NTIS.

Carotenoids are present in the chloroplasts of photosynthetic green plants and serve as photoprotect devices against the formation of damaging singlet oxygen and as light harvesting antenna pigments in photosynthetic organisms. They also appear to serve other functions as well. Electron transfer in photosystem II, either light induced or under oxidizing conditions, gives rise to an additional absorption attributed to a carotenoid cation radical. It has been shown that electron transfer reactions which generate energetic charge-separated states can also involve carotenoid cation radicals (Moore, Gust et al.). To better understand the role of carotenoids and carotenoid cation radicals in photosynthetic organisms and to characterize their properties, the authors have carried out EPR, ENDOR, optical, molecular orbital (AM1, INDO, and RHF-INDO/SP) and electrochemical studies. The carotenoid cation radicals have been produced electrochemically, radiolytically and photolytically as a function of host matrix.

3843 (SERI/CP–236-4396, pp. 81-83) **Ultrafast pump-probe studies of electronic excitation transport in photosynthetic antennae.** Lin, S. (Ames Laboratory-USDOE, IA (United States)); Lyle, A.; Struve, W.S. Solar Energy Research Inst., Golden, CO (United States). [1991]. (CONF-9106213–Absts.: 15. Department of Energy (DOE) solar photochemistry research conference, Snowmass, CO (United States), 2-6 Jun 1991). In *Fifteenth DOE solar photochemistry research conference.* 165p. Order Number DE91002165. Source: OSTI; NTIS.

The authors group has recently studied two current issues surrounding electronic excitation transport (EET) in photosynthetic antennae. The first of these is the question of how long exciton coherence persists during EET in antennae with strong exciton coupling between chromophores. The second issue is the nature of phonon participation in EET for antennae in which the chromophores. The second issue is the nature of phonon participation in EET for antennae in which the chromophores are complexed with proteins. The experimental technique is based on polarized pump-probe characterization of absorbance difference spectra. The time resolution is essentially laser pulse-limited, and has been refined to between 100 and 200 fs using group velocity dispersion (GVD) compensation in their hybrid mode-locked dye lasers.

3844 (SERI/CP–236-4396, pp. 85-88) **Porphyrin chemistry.** Barkigia, K.M. (Brookhaven National Lab., Upton, NY (United States)); Fajer, J.; Furenlid, L.R.; Renner, M.W.; Thompson, M.A. Solar Energy Research Inst., Golden, CO (United States). [1991]. (CONF-9106213–Absts.: 15. Department of Energy (DOE) solar photochemistry research conference, Snowmass, CO (United States), 2-6 Jun 1991). In *Fifteenth DOE solar photochemistry research conference.* 165p. Order Number DE91002165. Source: OSTI; NTIS.

Porphyrin derivatives mediate a wide spectrum of bioenergetic reactions ranging from light-harvesting and energy conversion in photosynthesis to multielectron transfers in reactions as diverse as nitrogen assimilation, regiospecific syntheses and conversion of carbon dioxide to methane. This program seeks to define the electronic configurations that control these multifaceted mechanisms by a combination of experimental, structural and theoretical approaches that considers the cumulative effects of macrocycle, substituents, metal, ligands, conformations, aggregation, and environment (protein or solvent) in fine-tuning the photophysics, photochemistry, and electron-transfer properties of porphyrins. The work encompasses photochemistry, spectroelectrochemistry, magnetic resonance (ESR, ENDOR, NMR), x-ray diffraction, and synchrotron radiation techniques that are closely supported by several theoretical methods (extended Hueckel, INDO, and molecular dynamics).

3845 (SERI/CP–236-4396, pp. 93-96) **Characterization of the spectroscopic properties of chlorophylls as monolayer states.** Cotton, T.M. (Ames Lab., IA (United States)); Uphaus, R.A.; Kim, J.H. Solar Energy Research Inst., Golden, CO (United States). [1991]. (CONF-9106213–Absts.: 15. Department of Energy (DOE) solar photochemistry research conference, Snowmass, CO (United States), 2-6 Jun 1991). In *Fifteenth DOE solar photochemistry research conference.* 165p. Order Number DE91002165. Source: OSTI; NTIS.

Intermolecular electron transfer behavior of photosynthetic molecules in solution has been the subject of intense scrutiny for many years. In contrast, heterogeneous electron transfer between chlorophylls and surfaces (electrodes and semiconductors) has received relatively little attention. One goal of the authors monolayer research is to measure electrode kinetics for self-assembled and

Langmuir-Blodgett (L-B) monolayers of the chlorophylls. It is expected that these two methods for preparing monolayers on metal surfaces could result in differences in the mode of interaction between the chlorophylls and the electrode surface. The L-B method provides definitive information regarding orientation of molecules based on the surface isotherm measurements. Spectroscopic methods (linear dichroism, polarized resonance Raman and surface-enhanced Raman scattering) also provide orientational information.

3846 (SERI/CP–236-4396, pp. 97-99) **Coupling of redox proteins to photochemical electron transfer reactions in lipid bilayers.** Tollin, G. (Univ. of Arizona, Tucson (United States)); Zhao, Z.G.; Salomon, Z. Solar Energy Research Inst., Golden, CO (United States). [1991]. (CONF-9106213–Absts.: 15. Department of Energy (DOE) solar photochemistry research conference, Snowmass, CO (United States), 2-6 Jun 1991). In *Fifteenth DOE solar photochemistry research conference.* 165p. Order Number DE91002165. Source: OSTI; NTIS.

During the past five years, the authors have been involved in developing strategies for efficiently using redox proteins as electron acceptors and donors in biomimetic photochemical electron transfer systems based on chlorophyll dissolved in lipid bilayer vesicle membranes. Their most recent work has been directed at the following: (1) systems involving chlorophyll-photosensitized vectorial electron transfer from a reduced protein in the inner aqueous compartment of a vesicle to an oxidized protein in the outer aqueous compartment, and (2) the development of electrochemical systems for redox proteins, which utilize metal electrodes coated with a lipid bilayer.

3847 (SERI/CP–236-4396, pp. 101-103) **Importance of donor-acceptor interactions and of driving force in metalloprotein electron-transfer reactions.** Zhou, J.S. (Ames Lab., IA (United States)); Brothers, H.M.; Kostic, N.M. Solar Energy Research Inst., Golden, CO (United States). [1991]. (CONF-9106213–Absts.: 15. Department of Energy (DOE) solar photochemistry research conference, Snowmass, CO (United States), 2-6 Jun 1991). In *Fifteenth DOE solar photochemistry research conference.* 165p. Order Number DE91002165. Source: OSTI; NTIS.

Many of the redox agents in early photosynthesis are metal complexes embedded in proteins. The protein matrix may contribute to unidirectionality and high quantum yield of charge separation in the reaction center. One goal of this project is to clarify the role of the protein in electron-transfer reactions. To this end the authors have examined the redox reactions of cytochrome c and plastocyanin, as well as the cytochrome complex resulting from replacement of the iron atom with zinc and its reaction with plastocyanin.

3848 (SERI/CP–236-4396, pp. 107-111) **Dynamic structural effects in photoinduced charge-transfer reactions.** Hupp, J.T. (Northwestern Univ., Evanston, IL (United States)). Solar Energy Research Inst., Golden, CO (United States). [1991]. (CONF-9106213–Absts.: 15. Department of Energy (DOE) solar photochemistry research conference, Snowmass, CO (United States), 2-6 Jun 1991). In *Fifteenth DOE solar photochemistry research conference.* 165p. Order Number DE91002165. Source: OSTI; NTIS.

The kinetics, and therefore the overall energy conversion efficiencies, of many photoinduced charge-transfer reaction schemes are critically dependent upon the magnitude and identity of the vibrational structural changes accompanying the component molecular redox transformations. These vibrational effects largely define, of course, the Franck-Condon barrier to charge transfers, while also influencing the reaction dynamics. The foci of this project are: (1) to obtain experimental measures of vibrational barriers with complete mode specificity, (2) to link the structural measurements with contemporary theory in quantitative comparisons to directly measured rate processes, (3) to understand in precise molecular detail how vibrational phenomena may be coupled energetically to solvent reorganization effects, and (4) to identify and understand the roles played by key vibrational modes in electronic mixing and valence localization/delocalization phenomena.

3849 (SERI/CP–236-4396, pp. 111-113) **Photoinduced charge separation from the redox quenching of the excited states of transition metal complexes.** Hoffman, M.Z. (Boston Univ., MA (United States)). Solar Energy Research Inst., Golden, CO (United States). [1991]. (CONF-9106213–Absts.: 15. Department of Energy (DOE) solar photochemistry research conference, Snowmass, CO (United States), 2-6 Jun 1991). In *Fifteenth DOE solar photochemistry research conference.* 165p. Order Number DE91002165. Source: OSTI; NTIS.

The electron-transfer quenching of the excited state of a photosensitizer can be visualized as occurring via the formation of a geminate redox pair within a solvent cage as a result of the transfer of one electron. The efficiency of charge separation (η_{cs}), the most critical quantity that determines the efficacy of a photochemical redox system, is dictated by the kinetic competition between intramolecular electron transfer within the cage and the diffusional escape of the oxidized and reduced species into bulk solution, where these charge-separated intermediates undergo further redox reactions. When the photosensitizer is a transition metal coordination complex, the quenching process can yield a species in which the metal center has an unusual oxidation state or possesses a coordinated ligand-radical. The aims of this research are to determine the charge separation efficiencies of electron transfer quenching reactions as a function of thermodynamic, kinetic, and solution medium parameters, and to investigate the properties of the excited states and the one-electron oxidized and reduced forms of the photosensitizers and quenchers. The complexes of interest have been those of Ru(II) that possess diimine ligands; photochemical, photophysical, electrochemical, and radiation chemical techniques have been employed.

3850 (SERI/CP–236-4396, pp. 115-117) **Excited-state energy- and electron-transfer reactions in multimetal systems.** Petersen, J.D. (Clemson Univ., SC (United States)); Morgan, L.W.; Hsu, Iyun; Ronco, S.E. Solar Energy Research Inst., Golden, CO (United States). [1991]. (CONF-9106213–Absts.: 15. Department of Energy (DOE) solar photochemistry research conference, Snowmass, CO (United States), 2-6 Jun 1991). In *Fifteenth DOE solar photochemistry research conference.* 165p. Order Number DE91002165. Source: OSTI; NTIS.

The authors research has utilized the preparation of multimetal systems to covalently couple a highly-absorbing metal center (antenna fragment) to a second metal center capable of carrying out a useful chemical reaction (reactive fragment). This molecular design has been used in both excited-state energy- and electron-transfer processes. They have studied binuclear ruthenium/rhodium complexes as well as cobalt homologs in energy transfer processes. In electron-transfer/charge separation processes, they have investigated three component systems consisting of a light-absorbing antenna fragment with two metal centers coupled to it, one containing an electron donor and one containing an electron acceptor. Their most recent work has involved attempts to generate a simpler, two component system in which the antenna fragment also serves as the electron donor.

3851 (SERI/CP–236-4396, pp. 119-122) **Photochemical reactivity of Re(I) carbonyl complexes from the standpoints of monophotonic and sequential biphotonic irradiations.** Ferraudi, G. (Univ. of Notre Dame, IN (United States)). Solar Energy Research Inst., Golden, CO (United States). [1991]. (CONF-9106213–Absts.: 15. Department of Energy (DOE) solar photochemistry research conference, Snowmass, CO (United States), 2-6 Jun 1991). In *Fifteenth DOE solar photochemistry research conference.* 165p. Order Number DE91002165. Source: OSTI; NTIS.

Rhenium complexes of the form, $XRe(CO)_3L_2$, (X = halide, L = azine) have been shown to exhibit CT excited states which act as oxidants of sacrificial reagents, such as triethanolamine. The subsequent reduction products are very reactive species which form intermediates capable of reducing carbon dioxide. This behavior suggests that such compounds may be photochemical as well as electrochemical catalysts for the fixation of carbon dioxide. In order to improve the chemical characteristics of the rhenium complexes in catalysis, the mechanisms of several of the complexes have been investigated by flash and steady state photolysis.

3852 (SERI/CP–236-4396, pp. 123-126) **Redox reactions accompanied by bond formation and rupture.** Creutz, C. (Brookhaven National Lab., Upton, NY (United States)). Solar Energy Research Inst., Golden, CO (United States). [1991]. (CONF-9106213–Absts.: 15. Department of Energy (DOE) solar photochemistry research conference, Snowmass, CO (United States), 2-6 Jun 1991). In *Fifteenth DOE solar photochemistry research conference.* 165p. Order Number DE91002165. Source: OSTI; NTIS.

The rather sophisticated understanding of the parameters that determine the early events in both artificial and natural photosynthetic systems is in sharp contrast to current understanding and ability to control the chemical fate of the energy amassed in the light absorption step and transduced via one-electron transfer events. In artificial systems, mediators/catalysts for water decomposition or carbon dioxide reduction, for example, are limited in number and often rather poor in efficiency. The author's principle strategy has been to seek and characterize mediator systems that can be triggered by one-electron transfer reactions. In addition, she have recently begun a fundamental investigation of the factors that govern 'atom' transfer reactions at transition-metal centers.

3853 (SERI/CP–236-4396, pp. 129) **Manipulation and control of photoinduced charge transfer processes occurring at cadmium chalconide aqueous photoelectrochemical interface.** Chun, J. (Princeton Univ., NJ (United States)); Seshradi, G.; Bocarsly, A.B. Solar Energy Research Inst., Golden, CO (United States). [1991]. (CONF-9106213–Absts.: 15. Department of Energy (DOE) solar photochemistry research conference, Snowmass, CO (United States), 2-6 Jun 1991). In *Fifteenth DOE solar photochemistry research conference.* 165p. Order Number DE91002165. Source: OSTI; NTIS.

Although it is exceedingly difficult to oxidize CN^- to CNO^- at a metal electrode, the illuminated n-CdSe aqueous interface is observed to be an excellent system for the two-electron oxidation of cyanide. The authors have conducted experiments aimed at understanding the mechanism of this reaction. Experiments conducted with a n-CdS electrode in the same electrolyte have exhibited markedly different behavior in consistency with their assessment of the process as a surface controlled reaction.

3854 (SERI/CP–236-4396, pp. 130) **Spectroscopic and kinetic characterization of chlorine atom in solution.** Chateauneuf, J.E. (Univ. of Notre Dame, IN (United States)). Solar Energy Research Inst., Golden, CO (United States). [1991]. (CONF-9106213–Absts.: 15. Department of Energy (DOE) solar photochemistry research conference, Snowmass, CO (United States), 2-6 Jun 1991). In *Fifteenth DOE solar photochemistry research conference.* 165p. Order Number DE91002165. Source: OSTI; NTIS.

There have been several reported assignments of the transient UV absorption band observed following pulse radiolysis of pure carbon tetrachloride, including an erroneous assignment to dichlorocarbene. In the present study, time-resolved nanosecond absorption spectroscopy has been used to identify the transient responsible for this absorption as the chlorine atom.

3855 (SERI/CP–236-4396, pp. 132) **Charge-transfer interactions in MESO-linked porphyrin-anthraquinone molecules.** Connolly, J.S. (Solar Energy Research Inst., Golden, CO (United States)); Kamioka, Keiko; Cormier, R.A.; Lutton, T.W. Solar Energy Research Inst., Golden, CO (United States). [1991]. (CONF-9106213–Absts.: 15. Department of Energy (DOE) solar photochemistry research conference, Snowmass, CO (United States), 2-6 Jun 1991). In *Fifteenth DOE solar photochemistry research conference.* 165p. Order Number DE91002165. Source: OSTI; NTIS.

The authors have extended their studies of the meso-linked porphyrin-anthraquinone free base molecule to its zinc analogue in which the energy gap between the Zn-porphyrin S_1 state and the sum of the redox potentials is approximately 0.5 eV more negative than in the case of the free base. They have characterized both the zinc analogue and several substituted zinc-analogues using emission spectroscopy. Redox potentials have also been determined and compared.

3856 (SERI/CP–236-4396, pp. 133) **Zero-field splittings of the lowest excited states of zinc aromatic diimine-aromatic dithiol mixed-ligand complexes.** Crosby, G.A. (Washington State Univ., Pullman (United States)); Azumi, T. Solar Energy Research Inst., Golden, CO (United States). [1991]. (CONF-9106213–Absts.: 15. Department of Energy (DOE) solar photochemistry research conference, Snowmass, CO (United States), 2-6 Jun 1991). In *Fifteenth DOE solar photochemistry research conference.* 165p. Order Number DE91002165. Source: OSTI; NTIS.

Zero-field splittings of the emitting levels of several zinc aromatic diimine-aromatic dithiol mixed-ligand complexes have been measured by ODMR. For complexes of the type $Zn(4\text{-}X\text{-}PhS)_2(phen)$ resonances of the ^{3}-pi-pi* levels were observed for X = F_5, Cl, CH_3. For X = CH_3O resonances were detected for the ^{3}LLCT emitting manifold. For X = Cl, resonances were detected for both the ^{3}LLCT and ^{3}-pi-pi* emitting states. The observation of the splitting of the ^{3}LLCT spin sublevels is the first measurement of its kind.

3857 (SERI/CP–236-4396, pp. 134) **Photoinduced electron transfer reactions in zeolite cages.** Turbeville, W. (Ohio State Univ., Columbus (United States)); Dutta, P.K. Solar Energy Research Inst., Golden, CO (United States). [1991]. (CONF-9106213–Absts.: 15. Department of Energy (DOE) solar photochemistry research conference, Snowmass, CO (United States), 2-6 Jun 1991). In *Fifteenth DOE solar photochemistry research conference.* 165p. Order Number DE91002165. Source: OSTI; NTIS.

The primary thrust of this study has been to examine what influence does constraining $Ru(bpy)_3^{2+}$ in the supercages of zeolite Y have on the ground and excited states of this molecule as well as how it modifies the kinetics of the photoinduced electron transfer from the entrapped molecule to electron acceptors such as viologens. The role of the charge on the ion-exchangeable cation in the zeolite as well as the overall Si/Al ratio is being explored as a means of influencing the forward and back electron transfer rate. The role of the viologens in influencing the electron transfer rates is also being examined.

3858 (SERI/CP–236-4396, pp. 135) **Photochemistry and photophysics of square planar platinum (II) dithiolate complexes.** Zuleta, J.A. (Univ. of Rochester, NY (United States)); McDonald, J.M.; Eisenberg, R. Solar Energy Research Inst., Golden, CO (United States). [1991]. (CONF-9106213–Absts.: 15. Department of Energy (DOE) solar photochemistry research conference, Snowmass, CO (United States), 2-6 Jun 1991). In *Fifteenth DOE solar photochemistry research conference.* 165p. Order Number DE91002165. Source: OSTI; NTIS.

Square planar luminescent complexes of platinum (II) having the general formula $PtL_2(S\text{-}S)$ where S-S is either ethyl-2-cyano-3,3-dithiolatoacrylate or maleonitriledithiolate have been investigated. Absorption and emission spectra have been compiled for and redox reactions have been conducted on several complexes. X-ray crystallography has also been used to confirm the geometry of the molecules.

3859 (SERI/CP–236-4396, pp. 136) **Photoinduced electron transfer in multinuclear transition metal complexes based on the $Ru^{II}(BPY)_2XY$ chromophore.** Buranda, T. (Wayne State Univ., Detroit, MI (United States)); Lei, Yabin; Song, Xiaoqing; Endicott, J.F. Solar Energy Research Inst., Golden, CO (United States). [1991]. (CONF-9106213–Absts.: 15. Department of Energy (DOE) solar photochemistry research conference, Snowmass, CO (United States), 2-6 Jun 1991). In *Fifteenth DOE solar photochemistry research conference.* 165p. Order Number DE91002165. Source: OSTI; NTIS.

Several series of complexes have been synthesized which contain the bypyridine-ruthenium(II) chromophore covalently bridged to one or to two potential acceptor metal (Cr, Rh, Co, Ru) complexes. Photoinduced energy or electron transfer has been examined in these complexes. Ps flash photolysis studies have also been conducted as a means of studying the forward and back electron transfer steps.

3860 (SERI/CP–236-4396, pp. 137) **Indirect laser-induced temperature-jump studies of interfacial phenomena: Some**

electron transfer rates and direct evidence for surface adsorption. Smalley, J.F. (Brookhaven National Lab., Upton, NY (United States)); Feldberg, S.W. Solar Energy Research Inst., Golden, CO (United States). [1991]. (CONF-9106213–Absts.: 15. Department of Energy (DOE) solar photochemistry research conference, Snowmass, CO (United States), 2-6 Jun 1991). In *Fifteenth DOE solar photochemistry research conference.* 165p. Order Number DE91002165. Source: OSTI; NTIS.

The structure of an electrode interface and the dynamics of interfacial processes are intimately related. The authors have used the indirect laser-induced temperature-jump (ILIT) method to effect small changes in the interfacial temperature on a time scale of a few nanoseconds to provide a method for characterizing very fast interfacial phenomena. The present work will describe the characterization of the adsorption and electron-transfer associated with two redox couples: $Fe(CN)_6^{-3/-4}$ and $Ru(NH_3)_6^{+3/+2}$.

3861 (SERI/CP–236-4396, pp. 138) **Characterization of the interchain charge-generation mechanism of electronically conductive poly(3-methylthiophene).** Sun, Z.W. (Solar Energy Research Inst., Golden, CO (United States)); Frank, A.J. Solar Energy Research Inst., Golden, CO (United States). [1991]. (CONF-9106213–Absts.: 15. Department of Energy (DOE) solar photochemistry research conference, Snowmass, CO (United States), 2-6 Jun 1991). In *Fifteenth DOE solar photochemistry research conference.* 165p. Order Number DE91002165. Source: OSTI; NTIS.

In an effort to develop more effective polymer-based semiconductor systems for photoelectrochemical cells, the authors have examined the charge-generation mechanism in poly(3-methylthiophene) (PMeT) films. The charge carriers and band structure that evolve upon doping of electrochemically grown PMeT films were characterized as a function of film preparation conditions by optical absorption, infrared, and electron spin resonance measurements. Results are interpreted in terms of current theories of charge-carrier production in conductive polymers.

3862 (SERI/CP–236-4396, pp. 139) **Vectoral electron transfer mediation: Electrochemical characterization of self-assembled functionalized redox-active alkyl thiols on gold.** Collard, D.M. (Univ. of Texas, Austin (United States)); Fox, M.A. Solar Energy Research Inst., Golden, CO (United States). [1991]. (CONF-9106213–Absts.: 15. Department of Energy (DOE) solar photochemistry research conference, Snowmass, CO (United States), 2-6 Jun 1991). In *Fifteenth DOE solar photochemistry research conference.* 165p. Order Number DE91002165. Source: OSTI; NTIS.

The synthesis of molecular-scale current rectifying devices demands the placement of redox-active groups in a defined environment at a specified distance from the surface of a probe. The resulting assembly must then be addressable either by either electrochemical potential variation or photochemical excitation. Two possible arrangements for such redox-active assemblies exploit the known self-assembly of long chain alkyl thiols on metals. The authors have prepared monolayers of alkyl thiols on gold and used high speed cyclic voltammetry to probe for electron transfer mediation.

3863 (SERI/CP–236-4396, pp. 141) **Photochemical properties of covalently attached sensitizer/mediator or donor/acceptor complexes.** Fujita, Etsuko (Brookhaven National Lab., Upton, NY (United States)); Milder, S.; Brunschwig, B.S. Solar Energy Research Inst., Golden, CO (United States). [1991]. (CONF-9106213–Absts.: 15. Department of Energy (DOE) solar photochemistry research conference, Snowmass, CO (United States), 2-6 Jun 1991). In *Fifteenth DOE solar photochemistry research conference.* 165p. Order Number DE91002165. Source: OSTI; NTIS.

Photochemical reduction of carbon dioxide to carbon monoxide has been reported using $Ru(bpy)_3^{2+}$ as a sensitizer and $Nicyclam^{2+}$ (cyclam = 1,4,8,11-tetraazacyclotetradecane) as a catalyst. The authors are preparing complexes with potential catalysts of the macrocycle family which they studied previously, attached covalently to potential sensitizers of the polypyridyl family. One such complex is $Ru(bpy)_2(bpy\text{-}cyclamM_1)^{4+}$ (M_1 = H_2, Ni). They have analyzed the absorption and emission spectra of this compound and are currently investigating the lifetime of the excited state.

3864 (SERI/CP–236-4396, pp. 143) **Quantization effects in GaAs particles.** Uchida, H. (Solar Energy Research Inst., Golden, CO (United States)); Curtis, C.; Levi, D.H.; Heben, M.J.; Nozik, A.J. Solar Energy Research Inst., Golden, CO (United States). [1991]. (CONF-9106213–Absts.: 15. Department of Energy (DOE) solar photochemistry research conference, Snowmass, CO (United States), 2-6 Jun 1991). In *Fifteenth DOE solar photochemistry research conference.* 165p. Order Number DE91002165. Source: OSTI; NTIS.

The synthesis of size-quantized GaAs particles is a major objective in the study of size quantitation effects because of the vast amount of prior information and research on GaAs and the potential applications of quantized III-IV semiconductor particles in photocatalysis, non-linear optical devices, and novel optoelectronic systems. The authors have refined the synthesis of GaAs colloids to eliminate interferences from Ga complexes, and report absorption and photoluminescence spectra for pure quantized GaAs colloids; studies involving scanning tunneling microscopy are also presented.

3865 (SERI/CP–236-4396, pp. 144) **Quenching of luminescent probes in polyelectrolyte solutions.** Sassoon, R.E. (Univ. of Notre Dame, IN (United States)); Hug, G.L. Solar Energy Research Inst., Golden, CO (United States). [1991]. (CONF-9106213–Absts.: 15. Department of Energy (DOE) solar photochemistry research conference, Snowmass, CO (United States), 2-6 Jun 1991). In *Fifteenth DOE solar photochemistry research conference.* 165p. Order Number DE91002165. Source: OSTI; NTIS.

The quenching of excited chromophores that are bound to polyelectrolytes has been analyzed employing time-resolved luminescence. The system studied consisted of tris(2,2′-bipyridine)ruthenium(II) ions bound to a positively-charged poly-3,3′-ionene which interacts with various excited-state quenchers. The combinations of polyelectrolyte with different quencher ions present a variety of situations ranging from purely electrostatic to a mixture of partially hydrophobic and partially electrostatic interactions.

3866 (SERI/CP–236-4396, pp. 145) **Toward functionalized artificial bilayer membranes.** Hurst, J. (Oregon Graduate Inst., Beaverton, OR (United States)). Solar Energy Research Inst., Golden, CO (United States). [1991]. (CONF-9106213–Absts.: 15. Department of Energy (DOE) solar photochemistry research conference, Snowmass, CO (United States), 2-6 Jun 1991). In *Fifteenth DOE solar photochemistry research conference.* 165p. Order Number DE91002165. Source: OSTI; NTIS.

Unilamellar vesicles containing bound redox ions are, under some conditions, capable of mediating transmembrane oxidation-reduction reactions. For alkylmethylviologens embedded in dihexadecylphosphate vesicles, the author has identified two charge separation pathways. Current efforts are directed at constructing vesicle-organized assemblies in which transmembrane redox is controlled with ion gates. For this purpose, he is examining photogating mechanisms using amphiphilic spiropyrans, azobenzenes, dialkylstilbenes, and bacteriorhodopsin.

3867 (SERI/CP–236-4396, pp. 146) **Photochemistry and photophysics of solvatochromic dyes with donor-acceptor linkages bound in microdomains of acrylate or peptide polyelectrolytes.** Jones, G. (Boston Univ., MA (United States)); Oh, C.; Farahat, M. Solar Energy Research Inst., Golden, CO (United States). [1991]. (CONF-9106213–Absts.: 15. Department of Energy (DOE) solar photochemistry research conference, Snowmass, CO (United States), 2-6 Jun 1991). In *Fifteenth DOE solar photochemistry research conference.* 165p. Order Number DE91002165. Source: OSTI; NTIS.

The binding of the organic dyes styryl-7 and a newly synthesized acridinium chromophore, to polyelectrolytes in water has been investigated. Data provided include absorption and emission (lifetime, polarization) properties, and circular dichroism and other measures of polymer conformation transition. The effects of dye

loading on polyelectrolyte chains will be demonstrated and inferences drawn concerning net photochemical reaction within the polymer environment.

3868 (SERI/CP–236-4396, pp. 147) **Measurement of electron transfer rate constants at 2-dimensional semiconductor/solution interfaces.** Koval, C.A. (Univ. of Colorado, Boulder (United States)); Howard, J.N. Solar Energy Research Inst., Golden, CO (United States). [1991]. (CONF-9106213–Absts.: 15. Department of Energy (DOE) solar photochemistry research conference, Snowmass, CO (United States), 2-6 Jun 1991). In *Fifteenth DOE solar photochemistry research conference.* 165p. Order Number DE91002165. Source: OSTI; NTIS.

Layered metal dichalcogenide semiconductors have been shown to be excellent materials for studying fundamental processes at semiconductor/solution junctions. However, since the basal plane is the desired interface, edge sites from defects or the terminus of the crystal must be isolated. A minielectrochemical cell has been developed that allows spatial analysis of these semiconductors. Electrochemical experiments are performed in a small drop of electrolyte (2-3 mm diameter) placed on the semiconductor. Experiments thus conducted are reported.

3869 (SERI/CP–236-4396, pp. 148) **Studies of silicon photoelectrochemical cells under high injection conditions and n-GaAs/sulfide interfaces.** Kumar, A. (California Inst. of Tech., Pasadena (United States)); Lunt, S.R.; Ryba, G.N.; Lewis, N.S. Solar Energy Research Inst., Golden, CO (United States). [1991]. (CONF-9106213–Absts.: 15. Department of Energy (DOE) solar photochemistry research conference, Snowmass, CO (United States), 2-6 Jun 1991). In *Fifteenth DOE solar photochemistry research conference.* 165p. Order Number DE91002165. Source: OSTI; NTIS.

The behavior of Si/methanol-dimethylferrocene$^{+/0}$ junctions has been investigated under high injection conditions. Results of these experiments are discussed. High injection experiments were also used to probe the mechanism for the decrease in surface recombination of GaAs surfaces after treatment with inorganic sulfides, thiols, alkoxides, and amines. Time resolved photoluminescence decay curves were used to obtain the surface recombination velocity under high injection conditions by digital simulation.

3870 (SERI/CP–236-4396, pp. 149) **Exciplexes in supersonic jets.** Saigusa, Hiroyuki (Univ. of Akron, OH (United States)); Lim, E.C. Solar Energy Research Inst., Golden, CO (United States). [1991]. (CONF-9106213–Absts.: 15. Department of Energy (DOE) solar photochemistry research conference, Snowmass, CO (United States), 2-6 Jun 1991). In *Fifteenth DOE solar photochemistry research conference.* 165p. Order Number DE91002165. Source: OSTI; NTIS.

Fluorescence excitation and dispersed fluorescence spectra of jet-cooled van der Waals complexes involving various donors and acceptors have been investigated for the purpose of probing factors that influence the efficiency of exciplex formation. Experimental results suggest that the exciplex formation is driven largely by exciton resonance between the component molecules when poor electron acceptors and donors are involved. With good acceptors and donors, the intermolecular force leading to exciplex formation is essentially charge transfer.

3871 (SERI/CP–236-4396, pp. 150) **Kinetics and radical yields in photoreduction of protonated tetraphenyl porphyrin dication: Evidence for triplet 'triplex' formation.** Biczok, L. (Brandeis Univ., Waltham, MA (United States)); Linschitz, H. Solar Energy Research Inst., Golden, CO (United States). [1991]. (CONF-9106213–Absts.: 15. Department of Energy (DOE) solar photochemistry research conference, Snowmass, CO (United States), 2-6 Jun 1991). In *Fifteenth DOE solar photochemistry research conference.* 165p. Order Number DE91002165. Source: OSTI; NTIS.

The protonated dication of tetraphenyl porphyrin. H_4TPP^{2+} is more readily reduced than H_2TPP. The interaction of H_4TPP^{2+} triplet with a series of donors (aryl amines, hydroquinones) in acetone has been studied by laser flash photolysis. Experimental results agree with a scheme in which an initial triplet exciplex, $^3PQ^*$, can react further with an additional donor molecule. From the kinetics, the lifetime of the initial exciplex is estimated to be about 30 nanoseconds.

3872 (SERI/CP–236-4396, pp. 151) **Low-energy methylene group transfer reactions.** McCluskey, M.C. (Lawrence Berkeley Lab., CA (United States)); Frei, H. Solar Energy Research Inst., Golden, CO (United States). [1991]. (CONF-9106213–Absts.: 15. Department of Energy (DOE) solar photochemistry research conference, Snowmass, CO (United States), 2-6 Jun 1991). In *Fifteenth DOE solar photochemistry research conference.* 165p. Order Number DE91002165. Source: OSTI; NTIS.

Light-initiated methylene group transfer reactions, from ketene to nitric oxide and 1,3-butadiene, have been observed in argon matrices, at wavelengths below the dissociation threshold of ketene. The reactions lead to unique products, an immine-oxy radical, in the case of nitric oxide, and vinyl cyclopropane, in the case of 1,3-butadiene. The products were identified by their vibrational spectra, as measured by FTIR difference spectroscopy. Experimental results indicate one-photon processes. A mechanism for the ketene reaction has been developed.

3873 (SERI/CP–236-4396, pp. 152) **Mechanisms of interfacial redox processes on semiconductor particles.** Luangdilok, C. (Argonne National Lab., IL (United States)); Meisel, D. Solar Energy Research Inst., Golden, CO (United States). [1991]. (CONF-9106213–Absts.: 15. Department of Energy (DOE) solar photochemistry research conference, Snowmass, CO (United States), 2-6 Jun 1991). In *Fifteenth DOE solar photochemistry research conference.* 165p. Order Number DE91002165. Source: OSTI; NTIS.

The widespread application of semiconductor particles in energy conversion and photocatalytic systems heightens the quest for understanding of the mechanistic details of redox processes that occur at the semiconductor-electrolyte interface. With better understanding of these mechanisms, strategies for optimization of the photoinduced redox reactions could be developed. To this end, the authors have studied the mechanism of photo-oxidation processes at metal-oxide particle interfaces, in particular on TiO_2 particles. In parallel, they are also investigating the effect of surface modification of chalcogenide particles, in particular CdS particles, by a variety of thiol modified photosensitizers.

3874 (SERI/CP–236-4396, pp. 153) **Temperature dependence of the picosecond lifetime of $Pt_2(pop)_4^{4-}$.** Milder, S. (Brookhaven National Lab., Upton, NY (United States)); Brunschwig, B. Solar Energy Research Inst., Golden, CO (United States). [1991]. (CONF-9106213–Absts.: 15. Department of Energy (DOE) solar photochemistry research conference, Snowmass, CO (United States), 2-6 Jun 1991). In *Fifteenth DOE solar photochemistry research conference.* 165p. Order Number DE91002165. Source: OSTI; NTIS.

The lifetime of picosecond fluorescence of $Pt_2(pop)_4^{4-}$ (pop = meta-$P_2O_5H_2$) has been observed to increase with decreasing temperature. The longer low-temperature lifetimes can be attributed to a decrease in the rate of nonradiative decay of the $^1A_{2u}$ ($^1d\,\sigma^*$ to $p\,\sigma$) to the $^3A_{2u}$ ($^3d\,\sigma^*$ to $p\,\sigma$) state of the complex. Two mechanisms for the intersystem-crossing are discussed and compared with experimental data.

3875 (SERI/CP–236-4396, pp. 154) **Calculating electronic coupling through molecular bridges.** Miller, J.R. (Argonne National Lab., IL (United States)); Naleway, C.A.; Curtis, L.A. Solar Energy Research Inst., Golden, CO (United States). [1991]. (CONF-9106213–Absts.: 15. Department of Energy (DOE) solar photochemistry research conference, Snowmass, CO (United States), 2-6 Jun 1991). In *Fifteenth DOE solar photochemistry research conference.* 165p. Order Number DE91002165. Source: OSTI; NTIS.

Rates of electron transfer between donor and acceptor groups separated by rigid molecular bridges are strongly affected by the electronic coupling transmitted between the donor and acceptor through the bridge. Experimental data have often resulted in puzzles. The authors wish to address this situation by attempting to develop a new theoretical method for calculating electronic coupling interactions. An important goal of this theory is to develop an

intuitive understanding of how an electronic coupling passes through the bridge.

3876 (SERI/CP–236-4396, pp. 155) **Ultrafast surface reaction dynamics at semiconductor interfaces.** Miller, R.J.D. (Univ. of Rochester, NY (United States)). Solar Energy Research Inst., Golden, CO (United States). [1991]. (CONF-9106213–Absts.: 15. Department of Energy (DOE) solar photochemistry research conference, Snowmass, CO (United States), 2-6 Jun 1991). In *Fifteenth DOE solar photochemistry research conference.* 165p. Order Number DE91002165. Source: OSTI; NTIS.

Direct experimental studies of the electronic coupling at the interface are needed to further refine theoretical models of surface mediated electron transfer. One approach to this problem, which is emphasized here, is to use time domain techniques to measure the electron or hole carrier interfacial transfer or surface state trapping times at a semiconductor interface. Herein, the author describes the use of Surface Restricted Transient Grating Spectroscopy to the study of carrier reaction dynamics at semiconductor interfaces.

3877 (SERI/CP–236-4396, pp. 156) **Electron transfer reactions of metalloporphyrins. Effect of structure and medium on site of reaction in nickel and chromium porphyrins.** Neta, P. (National Inst. of Standards and Technology, Gaithersburg, MD (United States)); Nahor, G.S.; Guldi, D.; Hambright, P. Solar Energy Research Inst., Golden, CO (United States). [1991]. (CONF-9106213–Absts.: 15. Department of Energy (DOE) solar photochemistry research conference, Snowmass, CO (United States), 2-6 Jun 1991). In *Fifteenth DOE solar photochemistry research conference.* 165p. Order Number DE91002165. Source: OSTI; NTIS.

Certain metallophyrins catalyze specific reactions via oxidized or reduced states of their metal centers. In several metalloporphyrins, however, redox reactions involving the metal center may take place with nearly the same potential as those involving the porphyrin ligand, and the actual mode of reaction becomes critically dependent on minor changes in structure or medium. In this study, the initial products of one-electron reduction and oxidation of several metalloporphyrins (MP) have been examined by pulse radiolysis in various media to determine structural and medium effects on the site of electron transfer.

3878 (SERI/CP–236-4396, pp. 157) **Evidence for five, stable oxidation states in a binuclear iron macrocycle.** Mountford, H.S. (Univ. of the Pacific, Stockton, CA (United States)); Li, Aiping; Spreer, L.O.; Otvos, J.W.; Calvin, M. Solar Energy Research Inst., Golden, CO (United States). [1991]. (CONF-9106213–Absts.: 15. Department of Energy (DOE) solar photochemistry research conference, Snowmass, CO (United States), 2-6 Jun 1991). In *Fifteenth DOE solar photochemistry research conference.* 165p. Order Number DE91002165. Source: OSTI; NTIS.

The authors have examined the spectral and electrochemical properties of a coupled, di-macrocycle formed from the reaction of $[Fe(OH_2)_6](ClO_4)_2$ with the macrocycle, 1,4,8,11-tetraazacyclotetradecane in acetonitrile, over a period of several days. Each iron atom in the di-macrocycle also has two axially coordinated acetonitrile molecules. They have conducted crystal structure, infrared spectroscopy, and cyclic voltammetry of this compound. Experimental evidence indicates five possible stable oxidation states for this compound.

3879 (SERI/CP–236-4396, pp. 158) **Effects of molecular organization on interfacial pH and on base catalyzed reactions of chlorophyll at the lipid water interface.** Mingotaud, C. (Univ. of Notre Dame, IN (United States)); Chauvet, J.P.; Patterson, L.K. Solar Energy Research Inst., Golden, CO (United States). [1991]. (CONF-9106213–Absts.: 15. Department of Energy (DOE) solar photochemistry research conference, Snowmass, CO (United States), 2-6 Jun 1991). In *Fifteenth DOE solar photochemistry research conference.* 165p. Order Number DE91002165. Source: OSTI; NTIS.

Lipid headgroups, especially those bearing ionic moieties, are capable of producing significant changes in equilibria between ions in the bulk water phase and in the lipid-water interfacial region. A consequence of this behavior is seen in large shifts in pH at the surfaces of bilayer structures or spread monolayers. In the present study, lipid functionalized fluorescence probes, e.g. lipid-coumarin dyes, have been used to determine differences between bulk and interfacial pH, (ΔpH), in spread lipid monolayers as functions of lipid structure and molecular packing. It is found that even a zwitterionic lipid, such as dioleoylphosphatidylcholine, can exhibit a ΔpH of several units.

3880 (SERI/CP–236-4396, pp. 159) **The photophysical properties of platinum(II) complexes: Emission from ^{3}MLCT and ^{3}LC states.** Murtaza, Z. (Univ. of North Carolina, Charlotte (United States)); Blanton, C.; Rillema, D.P. Solar Energy Research Inst., Golden, CO (United States). [1991]. (CONF-9106213–Absts.: 15. Department of Energy (DOE) solar photochemistry research conference, Snowmass, CO (United States), 2-6 Jun 1991). In *Fifteenth DOE solar photochemistry research conference.* 165p. Order Number DE91002165. Source: OSTI; NTIS.

The photophysical properties of two different types of platinum(II) biphenyl complexes have been under examination. The series differ in ancillary ligands. Absorbtion, luminescence, and emission properties of the series have been characterized and correlated with various kinetic and mechanistic properties of the complexes. Complexes of both series undergo oxidative addition with methylene chloride to give platinum(IV) species.

3881 (SERI/CP–236-4396, pp. 160) **Resonance Raman spectra and redox properties of thiosemiquinone radical anion.** Tripathi, G.N.R. (Univ. of Notre Dame, IN (United States)); Armstrong, D.; Schuler, R.H. Solar Energy Research Inst., Golden, CO (United States). [1991]. (CONF-9106213–Absts.: 15. Department of Energy (DOE) solar photochemistry research conference, Snowmass, CO (United States), 2-6 Jun 1991). In *Fifteenth DOE solar photochemistry research conference.* 165p. Order Number DE91002165. Source: OSTI; NTIS.

Electron transfer from aromatic sulfur compounds generally occurs at higher rates, as compared to the corresponding oxygen and nitrogen compounds. This enhanced efficiency arises due to lower binding energy of the pπ-electrons on the sulfur atom. The authors have examined the electron transfer reactions in a number of aromatic sulfur systems by pulse radiolysis using transient absorption and resonance Raman spectroscopies. The redox properties, as measured by electron transfer rates and equilibria, can be understood in terms of the structural information provided by the Raman spectroscopy. The thiosemiquinone anion ($^-SC_6H_4S\cdot$) is an important sulfur radical, as its oxygen counterpart, p-benzosemiquinone radical anion ($O^-C_6H_4O\cdot$), plays a vital role as electron transport agent in natural photosynthesis.

3882 (SERI/CP–236-4396, pp. 164) **Parameterization of electron-transfer fluorescence quenching in the finite sink approximation.** Stevens, B. (Univ. of South Florida, Tampa (United States)); McKeithan, D.N.; Biver, C.J. Solar Energy Research Inst., Golden, CO (United States). [1991]. (CONF-9106213–Absts.: 15. Department of Energy (DOE) solar photochemistry research conference, Snowmass, CO (United States), 2-6 Jun 1991). In *Fifteenth DOE solar photochemistry research conference.* 165p. Order Number DE91002165. Source: OSTI; NTIS.

The finite sink modification of the Smoluchowski-Collins-Kimball expression: $1/k_Q(C) = 1/k^\circ + (1 - \rho/r_o)/k_D$ - provides a quantitative description of the dependence of the time-independent quenching rate constant $k_Q(C)$ on quencher concentration C in liquids if the sink radius r_o is assigned as the most probable nearest neighbor separation $(2\pi N'C)^{-1/3}$, and permits recovery of the relative diffusion coefficient D together with the limiting rate constant k_Q° $(C=0) = k_D k^\circ/(k_D + k^\circ)$.

3883 (SERI/CP–236-4396, pp. 165) **Photoinduced radical pairs. Theory of electron spin polarization, relaxation and electron transfer.** Tang, J. (Argonne National Lab., IL (United States)); Bowman, M.K.; Norris, J.R.; Wang, Z. Solar Energy Research Inst., Golden, CO (United States). [1991]. (CONF-9106213–Absts.: 15. Department of Energy (DOE) solar photochemistry research conference, Snowmass, CO (United States), 2-6 Jun 1991). In *Fifteenth DOE solar photochemistry research conference.* 165p. Order Number DE91002165. Source: OSTI; NTIS.

The electron spin polarization (ESP) of photoinduced radical pairs provides a special signature of both the kinetics and the energetics of the photochemistry occurring in natural and artificial photosynthesis. Previously, the authors developed a rigorous vector diagram description of ESP that the experimentalist can use to determine the mechanisms of photochemistry which produce the ESP observed in an EPR spectrum. The present description of ESP is quantitative and includes coherence, relaxation, and chemical kinetics through the application of the Redfield theory. Oscillatory phenomena associated with zero quantum coherence are also considered in depth.

3884 (SERI/CP–236-4396, pp. 171) **Synthesis and characterization of FAC-TRIS[8-(dimethylsilyl) quinoline] derivatives of iridium(III) and rhodium(III).** Djurovich, P.I. (Univ. of California, Santa Barbara (United States)); Safir, A.; Keder, N.; Watts, R.J. Solar Energy Research Inst., Golden, CO (United States). [1991]. (CONF-9106213–Absts.: 15. Department of Energy (DOE) solar photochemistry research conference, Snowmass, CO (United States), 2-6 Jun 1991). In *Fifteenth DOE solar photochemistry research conference*. 165p. Order Number DE91002165. Source: OSTI; NTIS.

The N, Si-chelating ligand, 8-(dimethsilyl)quinoline, has been prepared by coupling 8-bromoquinoline and chlorodimethylsilane with n-butyllithium in THF. Both rhodium and iridium complexes have been formed with the ligand. Structures for these complexes and absorption and emission characteristics have been established.

3885 (SERI/CP–236-4396, pp. 172) **Polymers at liquid-liquid interfaces: Photophysics and photoredox chemistry.** Webber, S.E. (Univ. of Texas, Austin (United States)); Chatterjee, P.K.; Hsiao, J.S. Solar Energy Research Inst., Golden, CO (United States). [1991]. (CONF-9106213–Absts.: 15. Department of Energy (DOE) solar photochemistry research conference, Snowmass, CO (United States), 2-6 Jun 1991). In *Fifteenth DOE solar photochemistry research conference*. 165p. Order Number DE91002165. Source: OSTI; NTIS.

The objective of this project is to effect charge separation from excited states of chromophores bound to amphiphilic polymers which are adsorbed at the interface between water and an immiscible organic solvent. Two polymer systems have been synthesized and are currently being studied: (1) poly(vinylnaphthalene-alt-maleic acid), (2) poly(styrene-alt-maleic acid-co-chromophore), where the chromophore is vinylphenanthracene, vinylpyrene, or a substituted vinylanthracene. Surface properties and the excited triplet state are emphases of these studies.

3886 (SERI/CP–236-4396, pp. 173) **Variable attenuation of intramolecular electron transfer rates with distance in oligoproline-bridged binuclear complexes.** Wishart, J.F. (Brookhaven National lab., Upton, NY (United States)); Ogawa, M.Y.; Isied, S.S. Solar Energy Research Inst., Golden, CO (United States). [1991]. (CONF-9106213–Absts.: 15. Department of Energy (DOE) solar photochemistry research conference, Snowmass, CO (United States), 2-6 Jun 1991). In *Fifteenth DOE solar photochemistry research conference*. 165p. Order Number DE91002165. Source: OSTI; NTIS.

Long distance electron transfer reactions across synthetic polypeptides and modified proteins are of great interest as models for electron transfer in biological systems. Recently, the authors have measured rates of intramolecular electron transfer from a Ru(II)(bpy-·) moiety to Co(III) across polypeptide chains ranging from two to six proline subunits (through-bond distances: 15-32 Angstroms). Their data provide strong evidence for a bridge-assisted electron transfer mechanism at longer distances and suggest that secondary protein structures may play a significant role in mediating electron-transfer reactions in biological processes.

3887 (SERI/CP–236-4396, pp. 174) **Characterization of the poly(3-methylthiophene):cadmium telluride junction.** Zhang, Jiguang (Solar Energy Research Inst., Golden, CO (United States)); Pugh, R.; Sun, Z.W.; Frank, A.J. Solar Energy Research Inst., Golden, CO (United States). [1991]. (CONF-9106213–Absts.: 15. Department of Energy (DOE) solar photochemistry research conference, Snowmass, CO (United States), 2-6 Jun 1991). In *Fifteenth DOE solar photochemistry research conference*. 165p. Order Number DE91002165. Source: OSTI; NTIS.

The optoelectrical properties and the charge-transfer mechanism of the poly(3-methylthiophene) (PMeT):n-CdTe junction have been investigated. Highly doped PMeT films were grown on n-CdTe crystals by photoelectrochemical oxidation of the monomer. Illumination of the junction through the polymer layer with polychromatic light (100 mW/cm^2) produced a short-circuit photocurrent density of approx. 2 mA/cm^2, an open-circuit photovoltage of approx. 0.36 - 0.48 V, and in the best case, a fill factor of 0.67. The reaction mechanism was also investigated.

4006 Radiation Chemistry

Refer also to citation(s) 4337

3888 (DOE/ER/00038–3540) **University of Notre Dame Radiation Laboratory quarterly report, July 1–September 30, 1992.** Notre Dame Univ., IN (United States). Radiation Lab. 20 Oct 1992. 32p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC02-76ER00038. (NDRL–3540;Q–141). Order Number DE93002838. Source: OSTI; NTIS; GPO Dep.

Summaries are presented of 47 research projects in radiation chemical and photochemical reactions.

3889 (INIS-mf–13375, pp. 31) **The selectivity in the reactions of hydrated electrons (e_{aq}) and hydroxyl radicals (OH) with solutions of gly-gly irradiated with ^{60}Co-gamma ray.** Mayouf, A.M. (Tajoura Nuclear Research Center, Tajoura/Tripoli (Libya)); Elayeb, A.A. Tajoura Nuclear Research Centre, Tripoli (Libyan Arab Jamahiriya). 1984. 82p. (CONF-8409421–: Seminar on the use of research reactors in fundamental and applied sciences, Tajoura (Libyan Arab Jamahiriya), 16 Sep 1984). In *Seminar on the use of research reactors in fundamental and applied sciences. Programme and abstracts.* Order Number DE93606515. Source: Also available from Tajoura Nuclear Research Centre, Tajoura/Tripoli, Libya.

Short communication. HYDROXYL RADICALS/glycylglycine; SOLVATED ELECTRONS/glycylglycine; AQUEOUS SOLUTIONS; CHEMICAL REACTION YIELD; GAMMA RADIATION; GLYCYLGLYCINE; RADIOLYSIS

4007 Radiochemistry and Nuclear Chemistry

Refer also to citation(s) 2695, 3289, 3770, 3773, 3814, 3915, 4280, 4289, 4307, 4318

3890 (CDTN/LR–29) **Synthesis, labelling with 131-iodine and control of metaiodobenzylguanidine (mIBG).** Mansouri, A.; Saada, B.; Benzaid, A. Centre de Developpement des Techniques Nucleaires, Algiers (Algeria). Lab. des Radiopharmaceutiques. Apr 1992. 23p. (In French). Order Number DE93606615. Source: OSTI; NTIS (US Sales Only); INIS.

The metaiodobenzylguanidine sulfate has been synthesized by condensation of cynamide with metaiodobenzylamine, followed by transformation of obtained salt in hydrogenocarbonate then in sulfate.After purification by recrystallization and identification by analysis methods, the cold molecule has been labeled with 131-iodine by solid state transfer isotopic exchange reaction in presence of ammonium sulfate and by aqueous solution catalysed by palladium chloride. After purification by passage through a silver chloride filter, the final product was the subject of physico-chemical, radioactive and biological control.

3891 (INIS-BR–2993) **Chemical effects in x-ray emission spectra.** Fernandes, N.G. Minas Gerais Univ., Belo Horizonte, MG (Brazil). Dept. de Quimica. 1982 119p. (In Portuguese). Order Number DE93606609. Source: OSTI; NTIS (US Sales Only); INIS.

The chemical bond influence in X-ray emission spectra of hafnium, iodine, iron, sulphur, aluminium and magnesium is detected. The position of one X-ray emission line is determined by three methods: parabolic profile; Gaussian distribution and extra-heavy maximum. (author).

3892 (INIS-BR–3029) **Production of ^{77}Br for medical application.** Bastos, M.A.V. Universidade Federal, Rio de Janeiro, RJ (Brazil). 1982 69p. (In Portuguese). Order Number DE93606616. Source: OSTI; NTIS (US Sales Only); INIS.

Bromine-77 is produced with the variable energy cyclotron (CV-28) at the Instituto de Engenharia Nuclear, via the ^{75}As. (α, 2 n) ^{77}Br reaction, by bombarding arsenic trioxide with 28 MeV alpha-particles. The thick target yield is 0.3 mCi/μAh. The target is dissolved in concentrated N H_4 OH and ^{77}Br, separated from arsenic, by an anionic exchange resin, is obtained carrier-free with a separation yield greater than 90%. All the process is remotely controlled using electric and pneumatic systems, manipulators and tongs. The quality control is made by atomic absorption and gamma-ray spectroscopy. The present production rate of Br-77 is 2.3 mCi per irradiation. (author).

3893 (INIS-mf–13375, pp. 26) **Separation of Zr-95 and Nb-95 from fission products and its extraction with HPM B_2P/mineral acid systems.** Al-Samarra, A.; El-Turki, A.; Al-Fard, S.; Zantuti, F. Tajoura Nuclear Research Centre, Tripoli (Libyan Arab Jamahiriya). 1984. 82p. (CONF-8409421–: Seminar on the use of research reactors in fundamental and applied sciences, Tajoura (Libyan Arab Jamahiriya), 16 Sep 1984). In *Seminar on the use of research reactors in fundamental and applied sciences. Programme and abstracts.* Order Number DE93606515. Source: Also available from Tajoura Nuclear Research Centre, Tajoura/Tripoli, Libya.

Short communication. NIOBIUM 95/solvent extraction; ZIRCONIUM 95/solvent extraction; FISSION PRODUCTS; TBP

3894 (INIS-mf–13375, pp. 29) **Production of organic radiopharmaceuticals in the Radiochemical Department of "Tajoura"RC.** Ibrahim, Kh.B.; Goltyapin, Yu. Tajoura Nuclear Research Centre, Tripoli (Libyan Arab Jamahiriya). 1984. 82p. (CONF-8409421–: Seminar on the use of research reactors in fundamental and applied sciences, Tajoura (Libyan Arab Jamahiriya), 16 Sep 1984). In *Seminar on the use of research reactors in fundamental and applied sciences. Programme and abstracts.* Order Number DE93606515. Source: Also available from Tajoura Nuclear Research Centre, Tajoura/Tripoli, Libya.

Short communication. RADIOPHARMACEUTICALS/production; RADIOPHARMACEUTICALS; PRODUCTION; USES

3895 (INIS-mf–13375, pp. 32-33) **Preparation of organic compounds labelled with low energy beta emitters.** Barakat, M.F. (Nuclear Chemistry Department, Nuclear Research Centre, Atomic Energy Authority, Cairo (Egypt)). Tajoura Nuclear Research Centre, Tripoli (Libyan Arab Jamahiriya). 1984. 82p. (CONF-8409421–: Seminar on the use of research reactors in fundamental and applied sciences, Tajoura (Libyan Arab Jamahiriya), 16 Sep 1984). In *Seminar on the use of research reactors in fundamental and applied sciences. Programme and abstracts.* Order Number DE93606515. Source: Also available from Tajoura Nuclear Research Centre, Tajoura/Tripoli, Libya.

Short communication. LABELLED COMPOUNDS/chemical preparation; AMINO ACIDS; AROMATICS; CARBON 14; REVIEWS; SULFUR 35

3896 (INIS-mf–13375, pp. 34) **A rapid solvent extraction method for separation of Th-234 from uranyl nitrate solution and its extraction by secondary amine.** Al-Samarrai, A.; Al-Waer, S.; Al-Fard, S. Tajoura Nuclear Research Centre, Tripoli (Libyan Arab Jamahiriya). 1984. 82p. (CONF-8409421–: Seminar on the use of research reactors in fundamental and applied sciences, Tajoura (Libyan Arab Jamahiriya), 16 Sep 1984). In *Seminar on the use of research reactors in fundamental and applied sciences. Programme and abstracts.* Order Number DE93606515. Source: Also available from Tajoura Nuclear Research Centre, Tajoura/Tripoli, Libya.

Short communication. THORIUM 234/solvent extraction; AMINES; AQUEOUS SOLUTIONS; URANYL NITRATES

3897 (INIS-mf–13375, pp. 36) **Production of Ce-141 and Pr-143 isotopes by the method of extraction.** Dawed, E.; Al-Waer, S.; Al-Muntaser, A.; Danilov, N.; Merenkov, S.; Trofimov, T. Tajoura Nuclear Research Centre, Tripoli (Libyan Arab Jamahiriya). 1984. 82p. (CONF-8409421–: Seminar on the use of research reactors in fundamental and applied sciences, Tajoura (Libyan Arab Jamahiriya), 16 Sep 1984). In *Seminar on the use of research reactors in fundamental and applied sciences. Programme and abstracts.* Order Number DE93606515. Source: Also available from Tajoura Nuclear Research Centre, Tajoura/Tripoli, Libya.

Short communication. CERIUM 141/solvent extraction; PRASEODYMIUM 143/solvent extraction

3898 (INIS-mf–13375, pp. 45-46) **The research nuclear reactor as a tool for radiotracer production and for neutron activation in ecological research.** Knaus, R.M. (Nuclear Science Center, Louisiana State University (USA)). Tajoura Nuclear Research Centre, Tripoli (Libyan Arab Jamahiriya). 1984. 82p. (CONF-8409421–: Seminar on the use of research reactors in fundamental and applied sciences, Tajoura (Libyan Arab Jamahiriya), 16 Sep 1984). In *Seminar on the use of research reactors in fundamental and applied sciences. Programme and abstracts.* Order Number DE93606515. Source: Also available from Tajoura Nuclear Research Centre, Tajoura/Tripoli, Libya.

Short communication. RESEARCH REACTORS/isotope production; FLUORINE 18; NEUTRON ACTIVATION ANALYSIS; TRACER TECHNIQUES

4008 Combustion, Pyrolysis, and High-Temperature Chemistry

Refer also to citation(s) 2742, 4063

3899 (CONF-8910289–7) **Burning of a spherical fuel droplet in a uniform subsonic flowfield.** Madooglu, K.; Karagozian, A.R. California Univ., Los Angeles, CA (United States). Dept. of Mechanical, Aerospace and Nuclear Engineering. [1989]. 26p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG03-88ER13910. From Western States Section meeting of the Combustion Institute; Livermore, CA (United States); 23-24 Oct 1989. Order Number DE93002224. Source: OSTI; NTIS; GPO Dep.

An analytical/numerical model is described for the evaporation and burning of a spherical fuel droplet in a subsonic crossflow. The external gaseous flowfield is represented using an approximate compressible potential solution, while the internal flowfield of the droplet is represented by the classical Hill's spherical vortex. This allows numerical solution for the external boundary layer and diffusion flame characteristics to be made, from which the droplet's effective drag coefficient, rate of mass loss, size, and flame shape are determined. Comparison with experimental data indicate good agreement, and thus the potential for such simplified models in performing parametric studies.

3900 (DOE/ER/13571–T2) **Combustion Research Program: Flame studies, laser diagnostics, and chemical kinetics: Final report, 15 July 1987–15 June 1992.** Crosley, D.R. SRI International, Menlo Park, CA (United States). Molecular Physics Lab. Sep 1992. 24p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG03-86ER13571. Order Number DE93002758. Source: OSTI; NTIS; GPO Dep.

This project has comprised laser flame diagnostic experiments, chemical kinetics measurements, and low pressure flame studies. Collisional quenching has been investigated for several systems: the OH radical, by H_20 in low pressure flames; the rotational level dependence for NH, including measurements to J=24; and of NH_2 at room temperature. Transition probability measurements for bands involving v′ = 2 and 3 of the A-X system of OH were measured in a flame. Laser-induced fluorescence of vinyl radicals was unsuccessfully attempted. RRKM and transition state theory calculations were performed on the OH + C_2H_4 reaction, on the t-butyl radical + HX; and transition state theory has been applied to a series of bond scission reactions. OH concentrations were measured quantitatively in low pressure H_2/N_2O and H_2/O_2 flames, and the ability to determine spatially precise flame temperatures accurately using OH laser-induced fluorescence was studied.

3901 (DOE/ER/13910–T2) **Evaporation and burning of a spherical fuel droplet in a uniform convective flowfield.** Madooglu, K. California Univ., Los Angeles, CA (United States).

1992. 137p. Sponsored by USDOE, Washington, DC (United States); National Aeronautics and Space Administration, Washington, DC (United States). DOE Contract FG03-88ER13910. Grant NCC2-374. Order Number DE93002223. Source: OSTI; NTIS; GPO Dep.

An analytical/numerical model is developed for the evaporation and burning of a spherical fuel droplet in a subsonic crossflow. The external gaseous flowfield is represented using an approximate compressible potential-flow solution, while the internal flowfield of the droplet is represented by the classical Hill's spherical vortex. This allows a numerical solution for the external boundary layer, from which the droplet's effective drag coefficent, rate of mass loss, size, and the shape of the diffusion flame with infinitely fast chemical reaction kinetics are determined. Subsequently, the quasi-steady model with uniform liquid temperature is extended to examine the effects of the transient heating of the droplet interior. Time-dependent calculations are performed with updated droplet Reynolds numbers and updated surface temperatures. Comparisons of model predictions with experimental data are made. To examine the effects of finite-rate chemical reaction kinetics, a one-step formulation of the combustion mechanism is integrated into the gaseous boundary layer equations. Simplifying assumptions for the variation of gas properties commonly used in combustion calculations, are subjected to an examination as to their degree of accuracy. For this purpose, the droplet model is extended to account for the variation of gas properties with temperature and gas composition within the boundary layer. Comparisons are made between the predictions obtained from the different models developed in this study, as well as with existing experimental data.

3902 (DOE/ER/13910–T3) **Transverse liquid fuel jet breakup, burning, and ignition.** Li, H. California Univ., Los Angeles, CA (United States). 1990. 101p. Sponsored by USDOE, Washington, DC (United States); National Aeronautics and Space Administration, Washington, DC (United States). DOE Contract FG03-88ER13910. Grant NCC 2-374. Order Number DE93002222. Source: OSTI; NTIS; GPO Dep.

An analytical/numerical study of the breakup, burning, and ignition of liquid fuels injected transversely into a hot air stream is conducted. The non-reacting liquid jet breakup location is determined by the local sonic point criterion first proposed by Schetz, et al. (1980). Two models, one employing analysis of an elliptical jet cross-section and the other employing a two-dimensional blunt body to represent the transverse jet, have been used for sonic point calculations. An auxiliary criterion based on surface tension stability is used as a separate means of determining the breakup location. For the reacting liquid jet problem, a diffusion flame supported by a one-step chemical reaction within the gaseous boundary layer is solved along the ellipse surface in subsonic crossflow. Typical flame structures and concentration profiles have been calculated for various locations along the jet cross-section as a function of upstream Mach numbers. The integrated reaction rate along the jet cross-section is used to predict ignition position, which is found to be situated near the stagnation point. While a multi-step reaction is needed to represent the ignition process more accurately, the present calculation does yield reasonable predictions concerning ignition along a curved surface.

3903 (SAND–90-0511) **Steam explosions of single drops of thermite-generated melts: 25 and 50 weight percent aluminum-iron oxide initial mixtures.** Nelson, L.S.; Fuketa, T.; Eatough, M.J.; Vigil, F.J.; Szklarz, D.D.; Wong, C.C.; Hyndman, D.A. Sandia National Labs., Albuquerque, NM (United States). Oct 1992. 209p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-76DP00789. Order Number DE93003231. Source: OSTI; NTIS (US Sales Only); GPO Dep.

This work compares the steam explosion behavior of single drops of melts generated by thermite reactions of stoichiometric (25 w/o–75 w/o) (STO) and aluminum-enriched (50 w/o–50 w/o) (ALD) powder mixtures. We developed methods to generate approximately 5 g drops of melt and determined that: (1) ALD thermite is almost 70 times harder to ignite than STO thermite on an energy- input basis for 10 g of starting material; (2) Steam explosions of ALD melt drops perform almost 2 times more pressure-volume work than STO melt drops per g of melt; (3) Metal-water chemical reactions are about 1.5 times more extensive with ALD than with STO melt drops per g of melt; and (4) STO melt drops are released, explode, and fragment as two-phase globules of mostly metallic Fe and mixed Fe-Al oxidic composition. The ALD melt behaves as a mixture of molten Al and Al-Fe alloys with smaller amounts of oxide. 71 figs, 23 tabs.

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3904 (DOE/CE/90053–T26) **Interagency Advanced Power Group semi-annual compilation of briefs, September 1992.** Horizon Data Corp., Reston, VA (United States). Power Information Center. 1 Oct 1992. 327p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC01-90CE90053. Order Number DE93000703. Source: OSTI; NTIS; GPO Dep.

Project briefs are presented for the chemical, electrical, MHD, mechanical, nuclear, solar, and systems working groups.

3905 (WSEO–92-027) **Energy Training Directory: Commercial education and training in the Northwest.** Winford, M. Washington State Energy Office, Olympia, WA (United States). [1992]. 345p. Sponsored by Washington State Energy Office, Olympia, WA (United States). Order Number DE93002362. Source: OSTI; NTIS.

This directory lists information on commercial energy training gathered from post-secondary schools, associations, and companies in Washington, Oregon, Idaho, and Montana. Presented information includes: technical categories, event titles, sponsors, contact agencies, addresses, phone numbers, and prerequisites. Specific areas of interest are: architecture, boilers, codes/standards/laws, computer software, electrical engineering, heating-ventilation and air conditioning, lighting, management and administration, mechanical engineering, operation and maintenance, power production, refrigeration, and renewable resources.

4202 Facilities, Equipment, and Techniques

Refer also to citation(s) 2698, 2707, 2708, 2709, 2710, 2711, 2715, 2755, 2775, 2842, 3112, 3114, 3291, 3293, 3533, 3951, 3957, 4035, 4433, 4451

3906 (CONF-9210174–1) **An inverse dynamic trajectory planning for the end-point tracking control of a flexible manipulator.** Kwon, D.S. (Oak Ridge National Lab., TN (United States)); Babcock, S.M.; Book, W.J. Oak Ridge National Lab., TN (United States). [1992]. 9p. Sponsored by USDOE, Washington, DC (United States); National Aeronautics and Space Administration, Washington, DC (United States). DOE Contract AC05-84OR21400. Grant: NAG 1-623. From 1992 Korean automated control conference (KACC); Seoul (Korea, Republic of); 19-21 Oct 1992. Order Number DE93000428. Source: OSTI; NTIS; GPO Dep.

A manipulator system that needs significantly large workspace volume and high payload capacity has greater link flexibility than typical industrial robots and teleoperators. If link flexibility is significant, position control of the manipulator's end-effecter exhibits the nonminimum phase, noncollocated, and flexible structure system control problems. This paper addresses inverse dynamic trajectory planning issues of a flexible manipulator. The inverse dynamic equation of a flexible manipulator was solved in the time domain. By dividing the inverse system equation into the causal part and the anticausal part, the inverse dynamic method calculates the feedforward torque and the trajectories of all state variables that do not excite structural vibrations for a given end-point trajectory. Through simulation and experiment with a single-link flexible manipulator, the effectiveness of the inverse dynamic method has been demonstrated.

3907 (CONF-921228–1) **Automatic tuning for a teleoperated arm controller.** Kress, R.L.; Jansen, J.F. Oak Ridge National Lab., TN (United States). [1992]. 5p. Sponsored by National Aeronautics and Space Administration, Washington, DC (United States). DOE Contract AC05-84OR21400. From 31. Institute of Electrical

and Electronics Engineers (IEEE) conference on decision and control; Tuscon, AZ (United States); 16-18 Dec 1992. Order Number DE93001647. Source: OSTI; NTIS; GPO Dep.

This paper addresses the problem of determining an optimal set of gains for a controller for a teleoperated arm. Specifically, an automatic tuning technique was applied and investigated for tuning an independent-joint proportional-derivative controller for a teleoperated manipulator. The Hooke and Jeeves method is used in conjunction with a one-dimensional search routine in the tuning algorithm. The algorithm was used to optimize gains for a two-link teleoperator simulation and the results of several optimizations were used to determine the best form for an input trajectory and cost function. The desired joint angle trajectory is taken from low-pass filtered step inputs with randomly generated magnitudes, which vary at a predetermined interval. Both positive and negative angles are generated, but they are constrained to lie within the manipulator work space. It was determined that the cost function should be based on tracking error, peak position error over the entire desired path, overshoot, actuator torque bounds, and gain limits. The optimized gains obtained from the simulation were applied to an actual teleoperator and some improvement was seen.

3908 (DESY–92-030) **Calculations of the photon dose behind concrete shielding of high energy proton accelerators.** Dworak, D. (Deutsches Elektronen-Synchrotron (DESY), Hamburg (Germany)); Tesch, K.; Zazula, J.M. Deutsches Elektronen-Synchrotron (DESY), Hamburg (Germany). Feb 1992. 17p. Order Number DE93728675. Source: OSTI; NTIS (US Sales Only); INIS.

The photon dose per primary beam proton behind lateral concrete shieldings was calculated by using an extension of the Monte Carlo particle shower code FLUKA. The following photon-producing processes were taken into account: capture of thermal neutrons, deexcitation of nuclei after nuclear evaporation, inelastic neutron scattering and nuclear reactions below 140 MeV, as well as photons from electromagnetic cascades. The obtained ratio of the photon dose to the neutron dose equivalent varies from 8% to 20% and it well compares with measurements performed recently at DESY giving a mean ratio of 14%. (orig.).

3909 (DOE/ER/14090–3) **Pulse propagation in inhomogeneous optical fibers: Progress report, September 15, 1991–September 14, 1992.** Menyuk, C.R. Maryland Univ., Baltimore, MD (United States). Dept. of Electrical Engineering. 29 May 1992. 10p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG05-89ER14090. Order Number DE93001838. Source: OSTI; NTIS; GPO Dep.

This report presents information on research focused on soliton propagation in optical fibers.

3910 (EGG-M–92101) **Sensing the gas metal arc welding process.** Carlson, N.M. (EG and G Idaho, Inc., Idaho Falls, ID (United States)); Johnson, J.A.; Smartt, H.B.; Watkins, A.D.; Larsen, E.D.; Taylor, P.L.; Waddoups, M.A. EG and G Idaho, Inc., Idaho Falls, ID (United States). [1992]. 20p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC07-76ID01570. (CONF-9211113–1: International conference on computerization of welding, Orlando, FL (United States), 3-6 Nov 1992). Order Number DE93001957. Source: OSTI; NTIS; GPO Dep.

Control of gas metal arc welding (GMAW) requires real-time sensing of the process. Three sensing techniques for GMAW are being developed at the Idaho National Engineering Laboratory (INEL). These are (1) noncontacting ultrasonic sensing using a laser/EMAT (electromagnetic acoustic transducer) to detect defects in the solidified weld on a pass-bypass basis, (2) integrated optical sensing using a CCD camera and a laser stripe to obtain cooling rate and weld bead geometry information, and (3) monitoring fluctuations in digitized welding voltage data to detect the mode of metal droplet transfer and assure that the desired mass input is achieved.

3911 (GA-A–20763) **Development of the GA-4 and GA-9 legal weight spent fuel casks.** Grenier, R.M. (General Atomics, San Diego, CA (United States)); Meyer, R.J.; Mings, W.J. General Atomics, San Diego, CA (United States). Sep 1992. 9p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC07-88ID12698 ;AC07-76ID01570. (EGG-M–92431;CONF-920905–38: 10. international symposium on the packaging and transportation of radioactive materials: PATRAM '92, Yokohama (Japan), 13-18 Sep 1992). Order Number DE93001925. Source: OSTI; NTIS; INIS; GPO Dep.

GA is nearing the completion of the final design of two legal weight truck spent fuel shipping casks, the GA-4 Cask for PWR fuel and the GA-9 Cask for BWR fuel. GA is developing the casks under contract to the US Department of Energy (DOE) Field Office, Idaho, as part of the Office of Civilian Radioactive Waste Management (OCRWM) Cask Systems Development Program (CSDP). The casks will transport intact spent fuel assemblies fro commercial nuclear reactors sites to a monitored retrievable storage facility or a permanent repository. The DOE initiated the Cask Systems Development Program in response to the Nuclear Waste Policy Act of 1982 which made DOE responsible for managing the program for permanent disposal of spent nuclear fuel and high-level waste. This paper describes developmental and design verification testing programs, and the present status of the GA-4 and GA-9 Cask designs.

3912 (GA-A–20764) **GA-4/GA-9 honeycomb impact limiter tests.** Koploy, M.A. General Atomics, San Diego, CA (United States). Sep 1992. 9p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC07-88ID12698. (EGG-M–92432;CONF-920905–41: 10. international symposium on the packaging and transportation of radioactive materials: PATRAM '92, Yokohama (Japan), 13-18 Sep 1992). Order Number DE93001945. Source: OSTI; NTIS; INIS; GPO Dep.

General Atomics (GA) is under contract to the US Department of Energy, Field Office, Idaho, to develop two legal weight truck casks for transportation of spent nuclear fuel. This development project supports the Office of Civilian Radioactive Waste Management mission goal to develop a safe and efficient transportation system. The GA-4 and GA-9 Casks transport four pressurized-water-reactor (PWR) and nine boiling-water-reactor (BWR) spent fuel assemblies, respectively. The GA-4 and GA-9 Casks have similar designs. They both are long (the GA-9 is a little longer) and have square cross-sections with rounded corners. At each end is an aluminum honeycomb impact limiter to absorb energy and limit forces during impact. To evaluate the effectiveness of the impact limiters, GA performed a test program to obtain data on the behavior of the impact limiters over the range of impact angles. The test program was divided into three phases. Phase 1 provided the basis for understanding the behavior of honeycomb and the effects of structural backing, operating temperature and impact velocities on the honeycomb crush strength. Phase 2 provided data on the behavior of the complete impact limiter at different angles. Based on the results of Phase 1 and Phase 2 tests, the impact limiter design was optimized prior to commencing Phase 3. Phase 3 tested the final impact limiter design over a range of angles, providing a complete characterization of the impact limiter behavior. This paper discusses the test program, the test results, and how these helped optimize the impact limiter design. It emphasizes the results obtained during Phase 3 of the test program. The results obtained during Phases 1 and 2 were reported previously. This paper also includes a discussion on how the test results compare with analytical predictions.

3913 (GA-A–20770) **Thermal testing of solid neutron shielding materials.** Boonstra, R.H. General Atomics, San Diego, CA (United States). Sep 1992. 9p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC07-88ID12698. (EGG-M–92433;CONF-920905–40: 10. international symposium on the packaging and transportation of radioactive materials: PATRAM '92, Yokohama (Japan), 13-18 Sep 1992). Order Number DE93001946. Source: OSTI; NTIS; INIS; GPO Dep.

Two legal-weight truck casks the GA-4 and GA-9, will carry four PWR and nine BWR spent fuel assemblies, respectively. Each cask has a solid neutron shielding material separating the steel body and the outer steel skin. In the thermal accident specified by NRC regulations in 10CFR Part 71, the cask is subjected to an 800°C environment for 30 minutes. The neutron shield need not perform any shielding function during or after the thermal accident, but its behavior must not compromise the ability of the cask to contain the radioactive contents. In May-June 1989 the first series of full-scale thermal tests was performed on three shielding materials: Bisco

Products NS-4-FR, and Reactor Experiments RX-201 and RX-207. The tests are described in Thermal Testing of Solid Neutron Shielding Materials, GA-AL 9897, R. H. Boonstra, General Atomics (1990), and demonstrated the acceptability of these materials in a thermal accident. Subsequent design changes to the cask rendered these materials unattractive in terms of weight or adequate service temperature margin. For the second test series, a material specification was developed for a polypropylene based neutron shield with a softening point of at least 280°F. The neutron shield materials tested were boronated (0.8–4.5%) polymers (polypropylene, HDPE, NS-4). The Envirotech and Bisco materials are not polypropylene, but were tested as potential backup materials in the event that a satisfactory polypropylene could not be found.

3914 (IEN-DERE-DIFIR–011/89) **Repair of dewars for liquid nitrogen.** Souza, M.C.L. Instituto de Engenharia Nuclear (IEN), Rio de Janeiro, RJ (Brazil). Dept. de Fisica. 15 Dec 1989. 5p. (In Portuguese). Order Number DE93607565. Source: OSTI; NTIS (US Sales Only); INIS.

The repair techniques of Dewar flasks is presented. The methods of evacuation of them, like the repair and manufacture of the new check valves for Dewar flasks vacuum are described. (C.M.).

3915 (KFK–4895) **Behavior of decontaminable coatings prior to and after exposure to ionizing radiation.** Kunze, S. (Kernforschungszentrum Karlsruhe GmbH (Germany). Inst. fuer Nukleare Entsorgungstechnik); Schmidt, H.R. Kernforschungszentrum Karlsruhe GmbH (Germany). Inst. fuer Nukleare Entsorgungstechnik. Mar 1992. 22p. Order Number DE93728950. Source: OSTI; NTIS (US Sales Only); INIS.

Coating applied on floors, walls and ceilings as well as on inserts of nuclear facilities were examined for their decontaminability, color, gloss, resistance to chemicals both before and after exposure to ionizing radiation (absorbed dose 0.3 MGy). It has been confirmed that reproducible results are obtained if during specimen irradiation sufficient air ventilation is provided. As a consequence, in the revised version of DIN 53781 only gamma irradiation under defined conditions of air supply at 25 $\pm$ 10deg C and absorbed dose rates $\leq$ 1000 Gy/h (10^5 rad/h) is permissible for the examination of coatings in nuclear facilities relevant to practical application (DIN 55991). Although the high absorbed dose rate exceeds application relevant absorbed dose rates by several orders of magnitude, it is reasonable for use in examinations optimized in terms of costs. (orig.).

3916 (KFK–5052) **Realtime graphics support for remote handling operations in complex working environments within the framework of a control, simulation and off-line programming system.** Kuehnapfel, U. Kernforschungszentrum Karlsruhe GmbH (Germany). Inst. fuer Reaktorentwicklung (IRE); Karlsruhe Univ. (T.H.) (Germany). Fakultaet fuer Maschinenbau. May 1992. 169p. (In German). Order Number DE93728944. Source: OSTI; NTIS (US Sales Only); INIS.

The application independent simulation system KISMET was developed. This tool gives a different approach compared to previously existing robot simulators. A hierarchical data structure approach is used for the definition of workcell geometry, assembly topology and mechanism kinematics. This database structure allows for presentation of interactively selectable levels of detail and is, therefore, especially useful for real-time rigid body simulation of complex RH-scenarios. With KISMET, assembly structures can be modelled in any number of detail levels. Workcell geometry, assembly topology and mechanisms can be defined interactively by means of the integrated modeller. The mechanism simulation allows for kinematical tree structures with any number of joints, planar closed chains, and interconnections between joints. Examples of novel simulation methods, data structures, and algorithms are presented for selected examples: the hidden surface problem, graphical presentation techniques, collision testing, and control of scene cameras (image simulation, fast positioning and tracking). Special attention is paid to the real-time problem. The way this system was realized within the UNIX world is shown as an example for geometric and kinematic modelling techniques that grant for the optimum use of the capabilities of high-performance graphics workstations. A further chapter is focussing on the use of standard interfaces for CAD model transfer (CAD*I, STEP) and robot programming (IRDATA). Examples of practical KISMET applications for remote handling in fusion reactors, in a nuclear fuel element reprocessing cell and in sensor based robotics are used to present the developed methods. (orig.).

3917 (LA–12415) **MCNP: Criticality safety benchmark problems.** Mendius, P.W. (ed.); Wagner, J.C.; Sisolak, J.E.; McKinney, G.W. Los Alamos National Lab., NM (United States). Oct 1992. 91p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. Order Number DE93002856. Source: OSTI; NTIS; GPO Dep.

This report investigates the suitability of the general purpose Monte Carlo transport code MCNP for criticality safety calculations. The increased use of radiation transport codes for criticality problems has produced a greater user and institutional demand for assurances that such codes give correct results. Responding to these requirements for code validation, MCNP has been benchmarked against the KENO standard test set. MCNP results are compared to KENO calculations, as well as experimental results, where available. A comparison of MCNP continuous energy and multigroup results indicates that the continuous energy cross sections are more accurate, and MCNP successfully predicts the experimental results, in some cases better than KENO, within the expected data and statistical uncertainties. This benchmark study demonstrates that MCNP can accurately and efficiently model a relatively broad spectrum of criticality problems. 24 figs, 3 tabs.

3918 (LIU-TEK-LIC–1992-09) **Models and control for force/torque sensors in robotics.** Linkoeping Studies in Science and Technology. Johansson, Gert. Linkoeping Univ. (Sweden). Dept. of Mechanical Engineering. Apr 1992. 53p. Order Number DE93607603. Source: OSTI; NTIS; INIS.

One of the important problems in automatic assembly is the relative positioning accuracy between the parts in the assembly process. Inaccurate positions cause large insertion forces, wear and might damage the parts. They can also completely disable the assembly process. A solution to this problem is to detect the positioning error and to make a relevant adjustment of the position or path. This thesis presents a solution based on active feedback of force/torque data from a wrist mounted sensor. A task independent control algorithm has been realized through a sensor model concept. The sensor model includes an algorithm that transforms force/torque input to relevant motion of the end effector. The transformation is specified by a set of parameters e.g. desired forces, compliance and stopping criteria. The problem with gravity forces for varying end effector orientation is compensated by an algorithm, divided into three complexity levels. The compensation method includes a calibration sequence to ensure valid end effector properties to be used in the algorithm. A problem with available robot technology is bad integration possibilities for external sensors. To allow necessary modifications and expansions, an open and general control system architecture is proposed. The architecture is based in a computer workstation and transputers in pipeline for the robot specific operations. (au).

3919 **Micro-valve pump light valve display.** Lee, Yee-Chun. To Dept. of Energy. 15 Jan 1991. USAA patent application 7-641,39. 16p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. Order Number DE93001988. Source: OSTI; NTIS; GPO Dep.

In this invention, a flat panel display incorporates a plurality of micro-pump light valves (MLV's) to form pixels for recreating an image. Each MLV consists of a dielectric drop sandwiched between substrates, at least one of which is transparent, a holding electrode for maintaining the drop outside a viewing area, and a switching electrode from accelerating the drop from a location within the holding electrode to a location within the viewing area. The substrates may further define non-wetting surface areas to create potential energy barriers to assist in controlling movement of the drop. The forces acting on the drop are quadratic in nature to provide a nonlinear response for increased image contrast. A crossed electrode structure can be used to activate the pixels whereby a large flat panel display is formed without active driver components at each pixel.

3920 **Flameless tube sealing apparatus.** McFarlan, J.T.; Zwick, B.D.; Avens, L.R. To Dept. of Energy. 4 Mar 1991. USAA patent application 7-663,48. 9p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. Order Number DE93002005. Source: OSTI; NTIS; GPO Dep.

A flameless sealer for glass and polymeric tubes uses a circular filament as a heating element and can be used for sealing relatively large diameter tubes while they are within a glovebox or other protected enclosure. The electrically conductive rods extending from a non-conductive base which defines an aperture for mounting the apparatus to a lattice rod of a glove box. A remotely located power supply provides electrical power to the filament. 2 figs.

3921 **Catwalk grate lifting tool.** Gunter, L.W. To Dept. of Energy. 5 Mar 1991. USAA patent application 7-665,52. 12p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC09-89SR18035. Order Number DE93002018. Source: OSTI; NTIS; GPO Dep.

This invention consists of a device for lifting catwalk grates comprising an elongated bent member with a handle at one end and a grate engaging means at the opposite end. The grate engaging means comprises a pair of notched braces and a hook that act in conjunction with each other to lock onto the grate and give mechanical advantage in lifting the grate.

3922 **Position sensing apparatus.** Gritzo, R.E. To Dept. of Energy. 11 Mar 1991. USAA patent application 7-666,97. 12p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. Order Number DE93002021. Source: OSTI; NTIS; GPO Dep.

This invention consists of linear and angular position sensors in which a distance measuring system is used in conjunction with a sloping surfaced conductive target. With the target attached to a movable member and a distance measuring sensor at a fixed location with respect to the target, any linear or angular movement of the movable arm will alter the distance between the target and the sensor in a linear manner. As these are linear systems, the distances between sensor and target are simply and directly transformable to linear and angular positions.

3923 (PNL–8373) **Evaluation of Machine Guarding course taught in Chicago, Illinois June 2, 1992–June 4, 1992.** Wright, T.S. Pacific Northwest Lab., Richland, WA (United States). Oct 1992. 16p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE93002973. Source: OSTI; NTIS; GPO Dep.

This report summarizes trainee evaluations for the Safety Training Section course, Machine Guarding which was conducted June 2–4 at Argonne National Laboratory, in Chicago, Illinois. This class was the third pilot course of the Machine Guarding class. This summary presents the quantitative course evaluations that trainees provided upon completion of the course. Appendix A provides a transcript of the trainees' written comments. Numeric course ratings were generally positive, and show that the course material and instruction were effective. Results from the final examination indicated that the students gained significant knowledge from the course.

3924 (SAND–91-2630C) **Design of an actively cooled plate calorimeter for the investigation of pool fire heat fluxes.** Koski, J.A. (Sandia National Labs., Albuquerque, NM (United States)); Keltner, N.R.; Nicolette, V.F.; Wix, S.D. Sandia National Labs., Albuquerque, NM (United States). [1992]. 8p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-76DP00789. (CONF-920905–23: 10. international symposium on the packaging and transportation of radioactive materials: PATRAM '92, Yokohama (Japan), 13-18 Sep 1992). Order Number DE92041157. Source: OSTI; NTIS; INIS; GPO Dep.

For final qualification of shipping containers for transport of hazardous materials, thermal testing in accordance with regulations such as 10CFR71 must be completed. Such tests typically consist of 30 minute exposures with the container fully engulfed in flames from a large, open pool of JP4 jet engine fuel. Despite careful engineering analyses of the container, testing often reveals design problems that must be solved by modification and expensive retesting of the container. One source of this problem is the wide variation in surface heat flux to the container that occurs in pool fires. Average heat fluxes of 50 to 60 kW/m^2 are typical and close the values implied by the radiation model in 10CFR71, but peak fluxes up to 150 kW/m^2 are routinely observed in fires. Heat fluxes in pool fires have been shown to be a function of surface temperature of the container, height above the pool, surface orientation, wind, and other variables. If local variations in the surface heat flux to the container could be better predicted, design analyses would become more accurate, and fewer problems will be uncovered during testing. The objective of the calorimeter design described in this paper is to measure accurately pool fire heat fluxes under controlled conditions, and to provide data for calibration of improved analytical models of local flame-surface interactions.

3925 (SAND–91-2682C) **Hazardous materials package performance regulations.** Russell, N.A.; Glass, R.E.; McClure, J.D.; Finley, N.C. Sandia National Labs., Albuquerque, NM (United States). [1991]. 6p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-76DP00789. (TTC–1142;CONF-920905–33: 10. international symposium on the packaging and transportation of radioactive materials: PATRAM '92, Yokohama (Japan), 13-18 Sep 1992). Order Number DE93000759. Source: OSTI; NTIS; GPO Dep.

This paper discusses a hazardous materials Hazmat Packaging Performance Evaluation (HPPE) project being conducted at Sandia National Laboratories for the US Department of Transportation Research & Special Programs Administration (DOT-RSPA) to look at the subset of bulk packagings that are larger than 2000 gallons. The objectives of this project are to evaluate current hazmat specification packagings and develop supporting documentation for determining performance requirements for packagings in excess of 2000 gallons that transport hazardous materials that have been classified as extremely toxic by inhalation (METBI).

3926 (SAND–92-1201C) **Variance of temporal moment estimates of a squared time history.** Smallwood, D.O. Sandia National Labs., Albuquerque, NM (United States). [1992]. 11p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-76DP00789. (CONF-9210176–3: 63. shock and vibration symposium, Las Cruces, NM (United States), 27 Oct 1992). Order Number DE93000753. Source: OSTI; NTIS; GPO Dep.

An earlier paper described the use of bandlimited temporal moments to characterize shocks and short duration nonstationary vibration. An important aspect of applying this technique is an appreciation of the magnitude of the errors which could be expected when estimating the temporal moments and other properties of the time histories which are functions of the estimated temporal moments. Examples of these other properties are: the centroid, τ; the rms duration, D; skewness, S; kurtosis, K; and the root energy amplitude, A_e. Estimates of the errors are important for choosing analysis parameters, like filter bandwidths, and when reviewing the reduced data. This paper will explore the variance of estimates of the temporal moments, and functions of the temporal moments, when computed for data. For a product model, it is shown that the normalized error can be expressed in terms of a BT (bandwidth x time) like product.

3927 (SAND–92-1722C) **Cooperation of mobile robots for accident scene inspection.** Byrne, R.H.; Harrington, J. Sandia National Labs., Albuquerque, NM (United States). [1992]. 7p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-76DP00789. (CONF-921181–4: ISRAM '92: 4th international symposium on robotics and manufacturing, Sante Fe, NM (United States), 11-13 Nov 1992). Order Number DE93002487. Source: OSTI; NTIS; GPO Dep.

A telerobotic system demonstration was developed for the Department of Energy's Accident Response group to highlight the applications of telerobotic vehicles to accident site inspection. The proof-of- principle system employs two mobile robots, Dixie and RAYBOT, to inspect a simulated accident site. Both robots are controlled serially from a single driving station, allowing an operator to take advantage of having multiple robots at the scene. The telerobotic system is described and some of the advantages of having more than one robot present are discussed. Future plans for the system are also presented.

3928 (SAND–92-1859C) **Design of a small Type B package for the shipment of radioactive gas.** York, A.R. II; Freedman, J.M.; Kincy, M.A.; Joseph, B.J. Sandia National Labs., Albuquerque, NM (United States). [1992]. 7p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-76DP00789. (CONF-920905–2: 10. international symposium on the packaging and transportation of radioactive materials: PATRAM '92, Yokohama (Japan), 13-18 Sep 1992). Order Number DE92040958. Source: OSTI; NTIS; INIS; GPO Dep.

Sandia National Laboratories has completed the design and is now fabricating packages for shipment of tritium gas in conformance with 10 CFR 71. The package, referred to as the AL-SX, is quite unique in that its contents are a radioactive gas, and a large margin of safety has been demonstrated through overtesting. The AL-SX is small, 42 cm in diameter and 55 cm tall, and weighs between 55 kg empty and up to a maximum of 60 kg with contents and is designed for a 20-year service life. This paper describes the design of the AL-SX and certification testing performed on AL-SX packages and discusses containment of tritium and AL-SX manufacturing considerations.

3929 (SAND–92-2214C) **Truncation effects on control design models.** Allen, J.J.; Lauffer, J.P. Sandia National Labs., Albuquerque, NM (United States). [1992]. 9p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-76DP00789. (CONF-921228–2: 31. Institute of Electrical and Electronics Engineers (IEEE) conference on decision and control, Tuscon, AZ (United States), 16-18 Dec 1992). Order Number DE93002480. Source: OSTI; NTIS; GPO Dep.

This paper studied the behavior of retained system poles and transmission zeros in a control design model when the model is truncated. The sensitivity of the transmission zeros due to the tuncation of system dynamics was analytically obtained. The sensitivity of system poles to the truncation of system dynamics was shown to be zero as expected. The effects of actuator-sensor type and location was also studied. The results were illustrated with two example problems. The effect of transmission zero shifts in control design models and the controllers designed from them was illustrated with an example.

3930 (WHC-SP–0842) **Maintenance Implementation Plan for the 222-S Laboratory.** Stark, T.E. Westinghouse Hanford Co., Richland, WA (United States). Jun 1992. 58p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-87RL10930. Order Number DE93001671. Source: OSTI; NTIS; GPO Dep.

This Maintenance Implementation Plan (MIP) has been developed for the 222-S Laboratory. The 222-S Laboratory is currently supporting the waste management, chemical processing, and environmental monitoring programs presently under Westinghouse Hanford Company (Westinghouse Hanford) responsibility. This is done through quality analytical and process chemistry services. Comparison of the present maintenance program to DOE Order 4330.4A was accomplished using a variety of sources including a self-assessment. The majority of the activities identified as being in partial compliance or noncompliance are in the areas of organization and administration, on-the-job training (OJT) and supervisor training, facilities, control of maintenance activities, and parts and materials. Other key areas of focus are the master equipment list, performance indicators, preventive maintenance (PM) evaluation, and a feedback system for improvements to the facility and work control.

3931 (WSRC-MS–92-260-Rev.1) **The WSRC Engineering Analyzer: Revision 1.** Beckmeyer, R.R.; Buckner, M.R. Westinghouse Savannah River Co., Aiken, SC (United States). [1992]. 12p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC09-89SR18035. Order Number DE93000595. Source: OSTI; NTIS; GPO Dep.

This report describes a multi-platform, multi-program engineering analysis tool that runs in either real-time or post-process modes, providing the analyst with a consistent, adaptable interface for 2-d color animation of time-oriented engineering data on any X-terminal.

3932 (WSRC-TR–92-428) **Telerobot tool maintenance using master-slave manipulators.** Kriikku, E.M. Westinghouse Savannah River Co., Aiken, SC (United States). 20 Aug 1992. 8p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC09-89SR18035. Order Number DE93002693. Source: OSTI; NTIS; GPO Dep.

The Savannah River Site (SRS) will process large bulky transuranic (TRU) waste items with a robotic gantry manipulator. The Savannah River Technology Center (SRTC) built a TRU Waste Test Facility (TWTF) to demonstrate this concept. The test robot uses several tools (i.e. plasma torch, chain saw, and gripper) to open, size reduce, and repackage simulated waste items. Waste processing campaigns in the TWTF show the various robot tools require periodic maintenance, such as replacing the torch tip and replacing saw blades. The primary objectives of this test were to determine if standard master-slave manipulators (MSMS) can complete remote robot tool maintenance, and if so, how long does the maintenance take. Test results show that MSMs completed 5 of 8 tool maintenance tasks attempted, and each task took 15 minutes or less. The three tasks that couldn't be completed involved specially designed tools, and these tools could be redesigned to allow remote MSM maintenance. MSMs can complete robot tool maintenance in a reasonable amount of time. This conclusion supports the SRS philosophy of remotely processing large bulky TRU waste items using a robotic gantry manipulator.

3933 (Y/EN–4661) **Impact of new DOE orders on existing facilities.** Denton, D.R.; Hunt, R.J.; Stoddart, W.C.T. Oak Ridge Y-12 Plant, TN (United States). 30 Jul 1992. 13p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OS21400. (CONF-9208117–17: 1992 Energy Facility Contractors Group (EFCOG) safety analysis workshop, Salt Lake City, UT (United States), 11-13 Aug 1992). Order Number DE92041221. Source: OSTI; NTIS; GPO Dep.

Most of the Department of Energy (DOE) facilities managed by Martin Marietta Energy Systems, Inc. (Energy Systems), were constructed before 1970, whereas a large body of technical information relating to the determination of natural phenomena hazards (earthquake, wind/tornado, flood) and analysis and desip methodologies have been developed since this date. Much of this new information has been incorporated in the current DOE orders and criteria. The ongoing process of making modifications and updating the safety documentation of the facilities at Oak Ridge requires that these facilities constructed before 1970 be evaluated using current criteria. The impact of natural phenomena requirements contained in new and revised DOE orders on the Oak Ridge Y-12 Plant* is described. Specifically, seismic hazards given in Design and Evaluation Guidelines for Department of Energy Facilities Subjected to Natural Phenomena Hazards, UCRL-15910, are compared with both the original seismic design basis and with sita-specific hazard curves developed using current DOE methodology. The impact of applying current analysis and design methodologies and higher levels of technical rigor to facilities constructed in the 1940s, 1950s, and 1960s is discussed. Energy Systems' methods of reconciling noncomplying structures with the requirements of current criteria are also presented.

3934 (YJT–92-12) **Equipment for deployment of canisters with spent nuclear fuel and bentonite buffer in horizontal holes.** Henttonen, V. (JP-Engineering Oy, Vantaa (Finland)); Suikki, M. Voimayhtioeiden Ydinjaetetoimikunta, Helsinki (Finland). Aug 1992. 62p. Order Number DE93607604. Source: OSTI; NTIS; INIS.

The study presents the predesign of equipment for the deployment of canisters in long horizontal holes. The canisters are placed in the centre of the hole and are surrounded by a bentonite buffer. In thE study the canisters are assumed to have a diameter of 1.6 m and a length of 5.9 m, including the hemispherical ends. Their total weight is 60 tonnes. The bentonite buffer after homogenization is 400 mm thick, making a total package diameter of 2.4 m. The deployment system consists of four wagons for handling The canisters and the bentonite blocks. To ensure safe emplacement, every part is installed separately in its final position. This also makes it possible to use small clearances between the canisters and the bentonite blocks and between the blocks and the rock wall. With small clearances, backfilling can be avoided. Another

basic design idea is that the wagons are equipped with wheels, which are in direct contact with the rock walls. Thus, rails, which have to be removed as the deployment progresses, are unnecessary. To minimize the time taken for deploying one canister, the wagons are designed so that only three trips from the service area to the deposit area are needed. Due to the radiation in the vicinity of the canisters, the wagons have to be teleoperated.

4204 Heat Transfer and Fluid Flow

Refer also to citation(s) 2576, 2908, 2941, 3053, 3303, 3899, 4115

3935 (ANL/ESD–16) **Influence of Prandtl number and effects of disruption shape on the performance of enhanced tubes with the separation and reattachment mechanism.** Arman, B.; Rabas, T.J. Argonne National Lab., IL (United States). Energy Systems Div. Apr 1992. 126p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-31109-ENG-38. Order Number DE93003624. Source: OSTI; NTIS; GPO Dep.

The pressure-drop and heat-transfer performance of an enhanced tube with transverse disruptions can be predicted with a numerical modeling method, an accomplishment not previously achieved. Two computer codes were employed to achieve this goal - an orthogonal code and a nonorthogonal, body-fitted code. The turbulence closure was achieved with a two-layer turbulence model. The orthogonal computer code was used to determine the influence of the Prandti number. The numerical simulations demonstrated that six distinct regions exist and that three zones dominate the thermal performance. The nonorthogonal, body-fitted numerical code was used to determine the thermohydraulic performance of enhanced tubes with transverse, periodic sine-, semicircle-, arc-, and trapezoid-shaped disruptions. The research showed that there was a trade-off between the heat-transfer and pressure-drop performances when the disruption shape becomes more contoured, and that the local heat transfer is strongly dependent on the shape in the vicinity of the disruption, but it is less dependent in the downstream recirculation region and in the boundary-layer development zone.

3936 (DOE/ER/13572–5) **Drop oscillation and mass transfer in alternating electric fields: Progress report, May 30, 1991–June 1, 1992.** Carleson, T.E. Idaho Univ., Moscow, ID (United States). Dept. of Chemical Engineering. 24 Jun 1992. 7p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG07-86ER13572. Order Number DE93003595. Source: OSTI; NTIS; GPO Dep.

In certain cases droplet direct contact heat transfer rates can be significantly enhanced by the application of an alternating electric field. This field can produce shape oscillations in a droplet which will enhance mixing. The theoretical evaluation of the effect of the interaction of the field with drop charge on the hydrodynamics has been completed for small amplitude oscillations. Previous work with a zero order perturbation method was followed up with a first order perturbation method to evaluate the effect of drop distortion on drop charge and field distribution. The first order perturbation results show secondary drop oscillations of four modes and two frequencies in each mode. The most significant secondary oscillation has the same mode and frequency as the second mode oscillation predicted from the first order perturbation work. The resonant frequency of all oscillations decrease with increasing electric field strength and drop charge. Work is currently underway to evaluate the heat transfer enhancement from an applied alternating electric field.

3937 (DOE/ER/13673–T3) **Fundamental studies of fluid mechanics and stability in porous media: Progress report.** Homsy, G.M. Stanford Univ., CA (United States). Dept. of Chemical Engineering. Jul 1992. 9p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG03-87ER13673. Order Number DE93002519. Source: OSTI; NTIS; GPO Dep.

We have been active in four areas: Numerical and analytical studies of viscous fingering in miscible displacements, including non- monotonic mobility profiles; numerical and analytical studies of the effect of non-Newtonian fluid characteristics on instabilities; experimental studies of instabilities of moving contact lines for Newtonian and non-Newtonian fluids; and studies of natural convective energy transport due to time-dependent body forces.

3938 (DOE/ER/14136–2) **[Numerical and physical modelling of bubbly flow phenomena].** Syracuse Univ., NY (United States). [1992]. 18p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG02-90ER14136. Order Number DE93003145. Source: OSTI; NTIS; GPO Dep.

The objective of the research was to develop a sound theoretical framework for analyzing various two-phase flows. The macroscopic behavior of these flows depends on the details of the microstructure of the dispersion, and these details, in turn, depend on the nature of the flow. Given the very diverse nature of the flows and their complex dependence on the microstructure of the dispersion, it is unlikely that a single set of equations, similar to the Navier-Stokes equations for homogeneous fluids, will apply to all the different situations. Therefore, the aim was to develop general methodologies that can be used to examine specific situations and a general understanding about different kinds of macroscopic flows.

3939 (DOE/ER/25120–1) **Approximation of attractors and applications: Progress report, May 1, 1992–October 31, 1992.** Temam, R. Indiana Univ., Bloomington, IN (United States). Inst. for Scientific Computing and Applied Mathematics. 23 Oct 1992. 5p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG02-92ER25120. Order Number DE93002420. Source: OSTI; NTIS; INIS; GPO Dep.

The aim of the research project is to explore what can be learned about turbulence from the theoretical and computational viewpoints, using the dynamical systems approach to turbulence.

3940 (DOE/ER/60791–1) **Investigation of dispersion in porous media using fiber-optic technology.** Nielsen, J.M. (Environ Corp., Princeton, NJ (United States)); Pinder, G.F.; Kulp, T.J.; Angel, S.M. Princeton Univ., NJ (United States). School of Engineering. [1991]. 22p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG02-89ER60791. Order Number DE93003086. Source: OSTI; NTIS; GPO Dep.

This paper presents results of a laboratory investigation of characteristics of solute transport utilizing fiber-optic technology. In this work, we examine solute transport in a uniform homogeneous porous medium with a one dimensional flow system using a fiber-optic fluorimeter system. In a series of experiments, fiber-optic sensors are used in-situ in a packed column to make observations of species concentration at the microscopic level. The tracer that is employed is assumed to be ideal and the flow field is restricted to be fully saturated and laminar. Using data measured at the pore level, we study the spatial variability in the concentration field during miscible displacement and relate these observations to the macroscopic flow characteristics.

3941 (IC–92/163) **Quantum group and symmetry of the heat equation.** Jha, P.K. (Delhi Univ. (India). Dept. of Physics and Astrophysics); Tripathy, K.C. International Centre for Theoretical Physics, Trieste (Italy). Jul 1992. 9p. Order Number DE93607560. Source: OSTI; NTIS (US Sales Only); INIS.

The symmetry associated with the heat equation is re-examined using Lie's method. Under suitable choice of the arbitrary parameters in the Lie field, it is shown that the system exhibits SL(2,R) symmetry. On inspection of the q-analogue of the principal solution, we find broadening of the Gaussian-flow curve when q is varied from 1 to 0.002. The q-analogue of the general solution predicts the existence of additional degeneracy. (author). 8 refs, 1 fig.

3942 (IEN–22/91) **TURBO: a computer program for two-dimensional incompressible fluid flow analysis using a two-equations turbulence model.** Botelho, D.A.; Moreira, M.L. Instituto de Engenharia Nuclear (IEN), Rio de Janeiro, RJ (Brazil). Jun 1991. 146p. (In Portuguese). Order Number DE93607561. Source: OSTI; NTIS (US Sales Only); INIS.

The Reynolds turbulent transport equations for an incompressible fluid are integrated on a bi-dimensional staggered grid, for velocity and pressure, using the SIMPLER method. With the resulting algebraic relations it was developed the TURBO program, which final objectives are the thermal stratification and natural convection analysis of nuclear reactor pools. This program was tested

in problems applications with analytic or experimental solutions previously known. (author).

3943 (INIS-BR–2947) **Study of diffusion type cold traps in liquid sodium circuit.** Araujo, F.G.B. de. Universidade Federal, Rio de Janeiro, RJ (Brazil). Coordenacao dos Programas de Posgraduacao de Engenharia. 1974 144p. (In Portuguese). Order Number DE93607562. Source: OSTI; NTIS (US Sales Only); INIS.

The purpose of this thesis is to attain conclusions related with the work of the diffusion type cold traps. Primarily a mathematic formulation is established for a purification process, including the determination of the cold trap thermic field. With parameters obtained from the temperature field, purification characteristics were calculated allowing conclusions concerning the system's performance. (author).

3944 (KAERI/TR–238/92) **Experimental data base of turbulent flow in rod bundles using laser doppler velocimeter.** Chung, Moon Ki (Korea Atomic Energy Research Inst., Daeduk (Korea, Republic of)); Yang, Sun Kyu; Chung, Heung June; Won, Soon Yeun; Kim, Bok Deuk; Cho, Young Rho. Korea Atomic Energy Research Inst., Daeduk (Korea, Republic of). Jan 1992. 290p. Order Number DE93607563. Source: OSTI; NTIS (US Sales Only); INIS.

This report presents in detail the hydraulic characteristics measurements in subchannels of rod bundles using one-component LDV (Laser Doppler Velocimeter). In particular, this report presents the figures and tabulations of the resulting data. The detailed explanations about these results are shown in references publicated or presented at the conference. 4 kinds of experimental work were performed so far. (Author).

3945 (SAND–92-1996C) **An iterative finite-element collocation method for parabolic problems using domain decomposition.** Curran, M.C. Sandia National Labs., Albuquerque, NM (United States). [1992]. 18p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-76DP00789. (CONF-9206290–2: 6. international conference on domain decomposition methods in science and engineering, Como (Italy), 14-21 Jun 1992). Order Number DE93002279. Source: OSTI; NTIS; GPO Dep.

Advection-dominated flows occur widely in the transport of groundwater contaminants, the movements of fluids in enhanced oil recovery projects, and many other contexts. In numerical models of such flows, adaptive local grid refinement is a conceptually attractive approach for resolving the sharp fronts or layers that tend to characterize the solutions. However, this approach can be difficult to implement in practice. A domain decomposition method developed by Bramble, Ewing, Pasciak, and Schatz, known as the BEPS method, overcomes many of the difficulties. We demonstrate the applicability of the iterative BEPS ideas to finite-element collocation on trial spaces of piecewise Hermite bicubics. The resulting scheme allows one to refine selected parts of a spatial grid without destroying algebraic efficiencies associated with the original coarse grid. We apply the method to two dimensional time-dependent advection-diffusion problems.

4205 Materials Testing

Refer also to citation(s) 2954, 2965, 3056, 3324, 3448, 3610, 3912, 4045

3946 (ETDE-IT–92-75) **Two linear parallel probe method: Technology review.** Lanciani, A.; Maggioni, G.; Morabito, P.; Barberis, F.; Berti, R.; Capelli, A.; Sona, P.G. Ente Nazionale per l'Energia Elettrica, Milan (Italy). Centro di Ricerca Idraulica e Strutturale; Centro Informazioni Studi Esperienze (CISE), Milan (Italy). Dec 1990. 20p. (CONF-900971–4: 12. European conference on thermophysical properties: ECTP-12, Vienna (Austria), 24-28 Sep 1990). Order Number DE93729396. Source: OSTI; NTIS (US Sales Only).

The evaluation of thermal conductivity and thermal diffusivity of damp materials imposes severe requirements on the measurement method. Large thermal gradients and long-run time of the test can give rise to water migration which disturbs the measurement results. These effects can be avoided by the use of transient methods. The CISE research institute and ENEL (Italian Electricity Board)-CRIS have developed the two linear parallel probe (TLPP) method in order to measure the thermal conductivity and thermal diffusivity of materials for civil engineering such as concrete, rock and soil. Continuous improvements to the test methodology and to the probe performances have increased the reliability of the TLPP method. Systematic tests have been carried out on SRMs, as well as, on concrete and soil. A critical analysis of the early results is reported.

3947 (FhG-IzfP–910212-TW) **Ultrasonic testing of narrow welded seams of an austenitic high temperature gas turbine rotor. Final report.** Walte, F.; Mueller, W.; Kapitza, H. Fraunhofer-Institut fuer Zerstoerungsfreie Pruefverfahren, Saarbruecken (Germany); Bundesministerium fuer Forschung und Technologie, Bonn (Germany). 20 Jun 1991. 47p. (In German). Contract BMFT 0326500T. Order Number DE93728689. Source: OSTI; NTIS (US Sales Only).

The basis of an ultrasonic manufacturing test is to be worked out for narrow welded seams of a high temperature gas turbine rotor, which is welded together from separate disks (material Inconel 718). A study taking into account the acoustic material properties, the weld seam geometry and the obstacles to testing due to the geometry led to the selection of the LSAFT process (line synthetic aperture focussing technique) as the most promising test process. The application of the selected test process for a welded disk (mixed weld seam IN718/St572S) in the original geometry showed no signs of a significant welding fault. However, separation of the disk to prepare for destructive material tests showed some areas of the weld seam, which were only welded through to half (the wall thickness). As an analysis of the welding process showed, the different thermal coefficients of expansion of ferritic and Austenitic disks led to a wrong positioning of the electron beam and therefore to a failure of welding. The difference between the thermal coefficients of expansion was also the cause of the high internal compressive stresses which in turn led to great transparency for ultrasonics in the non-welded areas. If one takes these results and the additional investigations on part of a rotor disk into account, then it is proposed to use the LSAFT process with vertical longitudinal waves for a manufacturing test. (orig./MM).

3948 (IKE–6-139) **Computerized tomography using fast neutrons.** Maier-Schuler, P. Stuttgart Univ. (Germany). Inst. fuer Kernenergetik und Energiesysteme. Mar 1992. 142p. (In German). Order Number DE93729133. Source: OSTI; NTIS (US Sales Only); INIS.

The equipment is transportable and can be used at different neutron sources. CT-images are presented showing that it is possible to get good results by using CT with fast neutrons in non destructive testing. Small defects with high contrasts can be detected as well as larger defects with small differences in material density. Since the neutrons interact with the nuclei and not with the electron density the CT-images contain different information compared with X-ray or γ images. As neutron sources always emit γ-radiation too, this radiation can be detected simultaneously with the neutrons. Therefore one can get a γ CT-image along with the neutron image. For the examination of small samples or objects containing materials with great differences in the linear attenuation coefficients like Al and H_2 thermal neutrons have been used for CT-measurements too. A spatial resolution and a density resolution of 0.1 mm and about 5% respectively could be achieved in the CT-images with fast neutrons and 0.04 mm with thermal neutrons. (orig./HP).

3949 (KAERI/AR–334/91) **Pulse holographic measurement techniques.** Kim, Cheol Jung (Korea Atomic Energy Research Inst., Daeduk (Korea, Republic of)); Baik, Seong Hoon; Hong, Seok Kyung; Kim, Jeong Moog; Kim, Duk Hyun. Korea Atomic Energy Research Inst., Daeduk (Korea, Republic of). Jan 1992. 155p. (In Korean). Order Number DE93607634. Source: OSTI; NTIS (US Sales Only); INIS.

With the development of laser, remote inspection techniques using laser have been growing on. The inspection and measurement techniques by pulse holography are well-established technique for precise measurement, and widely used in various fields of industry

now. In nuclear industry, this technology is practically used because holographic inspection is remote, noncontact, and precise measurement technique. In relation to remote inspection technology in nuclear industry, state-of-the art of pulse HNDT (Holographic non-destructive testing) and holographic measurement techniques are examined. First of all, the fundamental principles as well as practical problems for applications are briefly described. The fields of pulse holography have been divided into the HNDT, flow visualization and distribution study, and other application techniques. Additionally holographic particle study, bubble chamber holography, and applications to other visualization techniques are described. Lastly, the current status for the researches and applications of pulse holography to nuclear industry which are carried out actively in Europe and USA, is described. (Author).

3950 (LA–12435-MS) **Static-stress analysis of dual-axis safety vessel.** Bultman, D.H. Los Alamos National Lab., NM (United States). Nov 1992. 24p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. Order Number DE93001860. Source: OSTI; NTIS; GPO Dep.

An 8-ft-diameter safety vessel, made of HSLA-100 steel, is evaluated to determine its ability to contain the quasi-static residual pressure from a high-explosive (HE) blast. The safety vessel is designed for use with the Dual-Axis Radiographic Hydrotest (DARHT) facility being developed at Los Alamos National Laboratory. A smaller confinement vessel fits inside the safety vessel and contains the actual explosion, and the safety vessel functions as a second layer of containment in the unlikely case of a confinement vessel leak. The safety vessel is analyzed as a pressure vessel based on the ASME Boiler and Pressure Vessel Code, Section VIII, Division 1, and the Welding Research Council Bulletin, WRC107. Combined stresses that result from internal pressure and external loads on nozzles are calculated and compared to the allowable stresses for HSLA-100 steel. Results confirm that the shell and nozzle components are adequately designed for a static pressure of 830 psi, plus the maximum expected external loads. Shell stresses at the shellto-nozzle interface, produced from external loads on the nozzles, were less than 700 psi. The maximum combined stress resulting from the internal pressure plus external loads was 17,384 psi, which is significantly less than the allowable stress of 42,375 psi for HSLA-100 steel.

3951 (LA-UR–92-3227) **New LANL Group M-7 two-stage gun: Double-diaphragm and wrap-around gas breech.** Sheffield, S.A.; Martinez, A.R. Los Alamos National Lab., NM (United States). [1992]. 13p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. (CONF-9210181–1: 43. Aeroballistic Range Association (ARA) meeting, Columbus, OH (United States), 2 Oct 1992). Order Number DE93000874. Source: OSTI; NTIS; GPO Dep.

A new two-stage gun is being installed in a high explosive testing facility at Los Alamos National Laboratory for the purpose of subjecting insensitive high explosives to controlled projectile impacts so that shock-to-detonation transition can be studied in detail. This gun has been patterned after guns designed by Alois Stilp at Ernst Mach Institut (EMI) in Freiburg and Wintersweiler, Germany. Several changes were made to adapt the design to our needs. The gun has a 100-mm diameter pump tube and 33-mm and 50-mm diameter launch tubes; both pump and launch tubes are 7.6 m long. We plan to use only helium as the reservoir gas. Large hydraulic clamps hold the gun together in three places during a shot; these are located on both sides of the transition section and at the breech. These clamps make gun conversions to different setups relatively simple, i.e., the two-stage gun can be converted into a single-stage gun. A gas breech has been designed which can be operated in either wrap-around or double-diaphragm mode with a maximum operating pressure of 15,000 psi. Two-stage gun calculations indicate that in the gas breech configuration, projectile velocities up to 4 km/s can be obtained using helium in both the breech and the reservoir. The gun has been fabricated and is being installed at the present time. Testing is expected to begin in early 1993 if the startup difficulties do not become excessive.

3952 (UCRL-ID–111967) **Modeling induction heating and electrodynamic forces.** Martin, R.W. Lawrence Livermore National Lab., CA (United States). Sep 1992. 16p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. Order Number DE93003336. Source: OSTI; NTIS; GPO Dep.

Experiments are being performed to investigate the dissolution of a hemispherical shell containing molten-plutonium in a simulated fire environment. The experimental assembly is heated in an induction furnace and held at temperature for several hours. The analyses presented in this report address the induction heating, magnetic field penetration, heat transfer and electrodynamic forces within the experimental assembly during steady-state operation. We consider two shell materials; vanadium and the titanium alloy Ti-6Al-4V.

4230 Marine Engineering

3953 (IFP–39660) **Models for studying offshore platforms foundations behavior.** Meimon, Y. Institut Francais du Petrole (IFP), 92 - Rueil-Malmaison (France); Lille-1 Univ., 59 - Villeneuve-d'Ascq (France). Feb 1992. 143p. (In French). Order Number DE93721311. Source: OSTI; NTIS (US Sales Only).

This document describes rheological models to calculate the behavior of offshore platforms foundations and the soil-structure interactions. Quality assurance is developed with the help of a codes validation methodology but quantification of code error is not yet well resolved. 154 refs., 87 figs., 2 tabs.

4250 Power Cycles

Refer also to citation(s) 3534

4260 Components, Electron Devices and Circuits

Refer also to citation(s) 3454, 3823, 3919, 3975, 4055, 4078, 4699, 4757

3954 (ANL/EP/CP–76192) **Laser beam diagnostics for kilowatt power pulsed YAG laser.** Liu, Yi; Leong, Keng H. Argonne National Lab., IL (United States). [1992]. 11p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-31109-ENG-38. (CONF-9210217–1: International congress on application of laser and electro-optics, Orlando, FL (United States), 25-29 Oct 1992). Order Number DE93002928. Source: OSTI; NTIS; INIS; GPO Dep.

There is a growing need for high power YAG laser beam diagnostics with the recent introduction of such lasers in laser material processing. In this paper, we will describe the use of a commercially available laser beam analyzer (Prometec) to profile the laser beam from a 1600 W pulsed Nd:YAG laser that has a 1 mm fiber optic beam delivery system. The selection of laser pulse frequency and pulse width for the measurement is discussed. Laser beam propagation parameters by various optical components such as fibers and lenses can be determined from measurements using this device. The importance of such measurements will be discussed.

3955 (LA-SUB–92-11) **Final executive summary for Vibronic Exchange Visible Laser Program.** Marinelli, W.J. (Physical Sciences, Inc., Andover, MA (United States)); Kessler, W.J.; Piper, L.G.; Davis, S.J.; Woodward, A.M.; Donohue, K. Los Alamos National Lab., NM (United States); Physical Sciences, Inc., Andover, MA (United States). Feb 1991. 295p. Sponsored by Department of Defense, Washington, DC (United States). DOE Contract W-7405-ENG-36. Contract 9X25-X1451-2. Order Number DE93001275. Source: OSTI; NTIS (US Sales Only); GPO Dep.

This Executive Summary constitutes the Final Report for the Vibronic Exchange Visible Laser Program funded by the Strategic Defense Initiative Organization and administered by Los Alamos National Laboratory. The goal of the program was the development of a short wavelength (less than 1 μm) chemical laser (SWCL). The report consist of a summary of the effort. The program's quarterly reports, which contain the details of each aspect of the program cited below, are included as appendices. The program commenced in July of 1985 and focussed on vibration to electronic energy transfer as a means to excite a SWCL candidate. Early in the program halogen and interhalogen diatomic molecules as well as Group IVa metals and metal fluorides were identified as possible lasants. Energy transfer from vibrationally excited N_2 and CO

was considered to be the most likely excitation mechanism. The program was funded in one year increments or phases. During the first phase two tasks were completed: energy transfer from vibrationally excited CO to potential lasants was investigated and a diagnostic was developed for determining ground state vibrational distributions in excited N_2.

3956 **Improved x-ray laser system, x-ray laser and method.** London, R.A.; Rosen, M.D.; Strauss, M. To Dept. of Energy. 29 Jan 1991. USAA patent application 7-647,07. 21p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. Order Number DE93001991. Source: OSTI; NTIS; GPO Dep.

Disclosed is an x-ray laser system comprising (a) a laser containing generating means for emitting short wavelength radiation, and (b) means external to said laser for energizing said generating means, wherein when the laser is in an operative mode emitting radiation, the radiation has a transverse coherence length to width ratio of from about 0.05 to 1. Also disclosed is a method of adjusting the parameters of the laser to achieve the desired coherence length to laser width ratio.

3957 **Relay extracting tool.** Looney, R.B. To Dept. of Energy. 4 Feb 1991. USAA patent application 7-650,26. 9p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC09-89SR18035. Order Number DE93001994. Source: OSTI; NTIS; GPO Dep.

This invention is comprised of a method and device for removing relays from circuit boards. The device comprising a handle portion, a base portion with a first arcuate cut with a first radius of curvature and a second arcuate cut with a smaller second radius of curvature, the second arcuate cut made in the periphery of the first arcuate cut, and a curved portion joining the handle portion to the base portion so that, when the base portion engages the underside of the relay and the handle is rotated about the curved portion, the relay is lifted by the base portion.

3958 **Strained-layer semiconductor devices including subsurface-patterned active layers.** Dodson, B.W. To Dept. of Energy. 8 Feb 1991. USAA patent application 7-652,73. 14p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-76DP00789. Order Number DE93001996. Source: OSTI; NTIS; GPO Dep.

A method is described for patterning subsurface features in a semiconductor device, wherein the semiconductor device includes an internal strained layer. The method comprises creating a pattern of semiconductor material over the semiconductor device, the semiconductor material having a predetermined thiCkness which stabilizes areas of the strained semIconductor layer that lie beneath the pattern. Subsequently, a heating step is applied to the semiconductor device to cause a relaxation in areas of the strained layer which do not lie beneath the semiconductor material pattern, whereby dislocations result in the relaxed areas and impair electrical transport therethrough. END OF RECORD BEGINNING OF RECORD <289>M93001926 <950>This report documents the theory and input requirements for the multidimensional component in RELAP5/MOD2.5, Version 3w. The equations in Cartesian and cylindrical coordinates are presented as well as the shallow water terms. The implementation of these equations is then discussed. Finally, the constitutive models and input requirements are then described. END OF RECORD BEGINNING OF RECORD <289>M93001980 <950>The five fundamental tools for a scientist: (1) technical ability; (2) integrity; (3) initiative and self-motivation; (4) creativity; and, (5) persistence. Examples are given as to why each of these attributes are significant. This report was presented at the banquet for outstanding science awards winners.

3959 **Vanadium-pumped titanium x-ray laser.** Nilsen, J. To Dept. of Energy. 13 Feb 1991. USAA patent application 7-654,45. 26p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. Order Number DE93001998. Source: OSTI; NTIS; GPO Dep.

A resonantly photo-pumped x-ray laser is formed of a vanadium and titanium foil combination that is driven by two beams of intense line focused optical laser radiation. Ground state neon-like titanium ions are resonantly photo-pumped by line emission from fluorine-like vanadium ions.

3960 **Phase stable rf transport system.** Curtin, M.T.; Natter, E.F.; Denney, P.M. To Dept. of Energy. 19 Feb 1991. USAA patent application 7-656,32. 14p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. Order Number DE93002000. Source: OSTI; NTIS; GPO Dep.

This invention is comprised of an RF transport system which delivers a phase-stable RF signal to a load, such as an RF cavity of a charged particle accelerator. A circuit generates a calibration signal at an odd multiple frequency of the RF signal where the calibration signal is superimposed with the RF signal on a common cable that connects the RF signal with the load. Signal isolating diplexers are located at both the RF signal source end and load end of the common cable to enable the calibration to be inserted and extracted from the cable signals without any affect on the RF signal. Any phase shift in the calibration signal during traverse of the common cable is then functionally related to the phase shift in the RF signal. The calibration phase shift is used to control a phase shifter for the RF signal to maintain a stable RF signal at the load.

3961 **Electrical receptacle.** Leong, R. To Dept. of Energy. 1991. Filed date 4 Mar 1991. USAA patent application 7-663,35. 37p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. Order Number DE93002004. Source: OSTI; NTIS; GPO Dep.

The invention is a receptacle for a three prong electrical plug which has either a tubular or U-shaped grounding prong. The inventive receptacle has a grounding prong socket which is sufficiently spacious to prevent the socket from significantly stretching when a larger, U-shaped grounding prong is inserted into the socket, and having two ridges to allow a snug fit when a smaller tubular shape grounding prong is inserted into the socket. The two ridges are made to prevent the socket from expanding when either the U-shaped grounding prong or the tubular grounding prong is inserted.

3962 **Apparatus and method for increasing the bandwidth of a laser beam.** Wilcox, R.B. To Dept. of Energy. 5 Mar 1991. USAA patent application 7-664,70. 24p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. Order Number DE93002011. Source: OSTI; NTIS; GPO Dep.

The present invention comprises a novel method and apparatus that, by sinusoidal cross-phase modulation, can provide a laser pulse having a very broad bandwidth while substantially retaining the input laser's temporal shape. The present invention may have use in a master oscillator system for a laser having a master oscillator-power amplifier (MOPA) configuration. The present invention comprises a first laser providing an output wavelength λ and a second laser providing a output wavelength shifted by a small amount to $\lambda + \Delta\lambda$. Each beam has a single, linear polarization. Each beam is coupled into a length of polarization-preserving optical fiber. The first laser beam is coupled into the optical fiber with the beam's polarization aligned with the fiber's main axis, and the second beam is coupled into the fiber with its polarization rotated from the main axis by a predetermined angle. Within the fiber, the main axis' polarization defines an interference beam and the orthogonal axis' polarization defines a signal beam. In the interference beam, the first laser beam and the parallel polarized vector component of the other beam interfere to create areas of high and low intensity, which modulates the signal beam by cross phase modulation. Upon exit from the optical fiber, the beams are coupled out and the modulated signal beam is separated out by a polarization selector. The signal beam can be applied to coherence reducing systems to provide an output that is temporally and spatially incoherent.

3963 **Sequential power-up circuit.** Kronberg, J.W. To Dept. of Energy. 5 Mar 1991. USAA patent application 7-664,91. 20p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC09-89SR18035. Order Number DE93002014. Source: OSTI; NTIS; GPO Dep.

This invention consists of a sequential power-up circuit for starting several electrical load elements in series to avoid excessive current surge, comprising a voltage ramp generator and a set of

voltage comparators, each comparator having a different reference voltage and interfacing with a switch that is capable of turning on one of the load elements. As the voltage rises, it passes the reference voltages one at a time and causes the switch corresponding to that voltage to turn on its load element. The ramp is turned on and off by a single switch or by a logic-level electrical signal. The ramp rate for turning on the load element is relatively slow and the rate for turning the elements off is relatively fast. Optionally, the duration of each interval of time between the turning on of the load elements is programmable.

3964 **Controlled metal-semiconductor sintering/alloying by one-directional reverse illumination.** Sopori, B.L. To Dept. of Energy. 19 Mar 1991. USAA patent application 7-671,23. 27p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC02-83CH10093. Order Number DE93002029. Source: OSTI; NTIS; GPO Dep.

Metal strips deposited on a top surface of a semiconductor substrate are sintered at one temperature simultaneously with alloying a metal layer on the bottom surface at a second, higher temperature. This simultaneous sintering of metal strips and alloying a metal layer on opposite surfaces of the substrate at different temperatures is accomplished by directing infrared radiation through the top surface to the interface of the bottom surface with the metal layer where the radiation is absorbed to create a primary hot zone with a temperature high enough to melt and alloy the metal layer with the bottom surface of the substrate. Secondary heat effects, including heat conducted through the substrate from the primary hot zone and heat created by infrared radiation reflected from the metal layer to the metal strips, as well as heat created from some primary absorption by the metal strips combine to create secondary hot zones at the interfaces of the metal strips with the top surface of the substrate. These secondary hot zones are not as hot as the primary hot zone, but they are hot enough to sinter the metal strips to the substrate.

3965 (SAND–92-1919C) **Discrepancies between charge-pumping, dual-transistor, and midgap measurements of D_{it}.** Schwank, J.R.; Fleetwood, D.M.; Shaneyfelt, M.R. Sandia National Labs., Albuquerque, NM (United States). [1992]. 3p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-76DP00789. (CONF-921226–4: 1992 Institute of Electrical and Electronic Engineers (IEEE) semiconductor interface specialists conference, San Diego, CA (United States), 9-13 Dec 1992). Order Number DE92040977. Source: OSTI; NTIS; GPO Dep.

Several different techniques are used to electrically characterize defects at or near the Si/SiO_2 interface. Three common methods are the charge-pumping, midgap, and dual-transistor techniques. Each of these techniques offer advantages and disadvantages compared to the others. For instance, charge-pumping measurements are not significantly affected by charge lateral non-uniformities and can provide high-sensitivity measurements of the average density of interface traps. However, charge-pumping measurements cannot provide accurate measurements of the number of charged oxide traps. In contrast both the dual-tranistor and midgap techniques can provide good estimates for threshold-voltage shifts due to oxide traps and interface traps, but these estimates can break down when significant charge lateral non-uniformities are present in the oxide. Considering the widespread use of these, techniques, it is of practical and theoretical importance to quantitatively compare them. At the SISC, we will present a detailed comparison of the charge-pumping, midgap, and dual-tranistor techniques. Values for the density of interface traps measured using the three techniques will be compared for n- and P-channel transistors fabricated using several different process technologies, and under different process technologies, and under different irradiation and anneal conditions. Discrepancies between the different techniques are observed. Causes for the discrepancies will be explored at the SISC.

3966 (UCRL-JC–111447) **Line overlap measurements for resonant photo-pumping of x-ray lasers.** Elliott, S.R.; Beiersdorfer, P.; Nilsen, J. Lawrence Livermore National Lab., CA (United States). 25 Aug 1992. 4p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. (CONF-920948–4: 6. international conference on physics of highly charged ions, Manhattan, KS (United States), 28 Sep - 2 oct 1992). Order Number DE93001620. Source: OSTI; NTIS; GPO Dep.

Measurements taken on the LLNL EBIT to search for the possible photo- pumping of the 3p-3s lasing transitions in Ne-like ions of elements with Z=30-40 and the 4d-4p lasing transitions in Ni-like ions of elements with Z=47-73 are reported. A high-resolution crystal spectrometer was used to measure wavelengths of the Ne-like 2p-4d and the Ni-like 3d-5f and 3d-6f laser level feeding transitions relative to candidate pump lines in various H-, He-, and Ni-like ions. To date, the most promising candidate is Ni-like Pt pumping Ne-like Rb at 2512 eV. The line energies differ by 0.4 ± 0.1 eV or by 160 ppm.

43 PARTICLE ACCELERATORS

Refer also to citation(s) 3908, 4468, 4774

3967 (INP–1480/PL) **Isochronous cyclotron AIC-144. Main parameters - application possibilities.** Schwabe, J. Institute of Nuclear Physics, Cracow (Poland). 1990. 40p. (In Russian). Order Number DE93607605. Source: OSTI; NTIS (US Sales Only); INIS.

The AIC-144 cyclotron is designed for application in nuclear physics, technology and medicine. The accelerator beam can be changed in wide range of energy (K=60-20). The beam intensity is continuously adjusted (0.5-1000 μA). A wide variety of particles can be accelerated (Z/A=1-0.29). The achieved energy spread of the proton beam is of the order of $\Delta E/E=10^{-3}$. (author).

3968 (INP–1507/PL) **Technical conditions of isochronous cyclotron AIC-144 Sigma at start-up on internal beam (d).** Schwabe, J. (and others); Doruch, H.; Bochenek, R. Institute of Nuclear Physics, Cracow (Poland). 1990. 16p. (In Polish). Order Number DE93607606. Source: OSTI; NTIS (US Sales Only); INIS.

The main results of works carried out on technical parameters concerning optimization of acceleration are given. The data on magnetic field structure, acceleration system, measuring systems sets, vacuum system and beam injection are presented. (A.S.).

4301 Design, Development, and Operation

Refer also to citation(s) 4451, 4752

3969 (BNL–47888) **Free-electron laser research and development at BNL.** Ben-Zvi, I. (Brookhaven National Lab., Upton, NY (United States)). Brookhaven National Lab., Upton, NY (United States). [1992]. 8p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC02-76CH00016. (CONF-9206294–1: 3. NSF-QEWB workshop on plasma science, New York, NY (United States), 4 Jun 1992). Order Number DE93000373. Source: OSTI; NTIS; GPO Dep.

Free-Electron Losers (FEL) are considered by many to be the fourth generation synchrotron light sources. The National Synchrotron Light Source (NSLS) at BNL is carrying out an extensive R&D program on short wavelength FEL leading towards a proposal for a VUV FEL User Facility. Research and development towards this goal are carried out at the Accelerator Test Facility (ATF). The ATF is a linac-laser complex capable of producing high brightness electron beams and high power loser pulses synchronized with the electrons. The ATF is the test bed for developing and testing the components needed for a successful UV-FEL At the some time the ATF is serving an advanced accelerator R&D program such as loser acceleration of electron beams and the interaction of intense laser pulses with high brightness electron beams.

3970 (BNL–47974) **Inverse Free Electron Laser accelerator.** Fisher, A. (Brookhaven National Lab., Upton, NY (United States)); Gallardo, J.; van Steenbergen, A.; Sandweiss, J. Brookhaven National Lab., Upton, NY (United States). Sep 1992. 21p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC02-76CH00016. (CONF-9206193–17: Advanced accelerator concepts workshop, Port Jefferson, NY (United States), 14-20 Jun 1992). Order Number DE93001963. Source: OSTI; NTIS; INIS; GPO Dep.

The study of the INVERSE FREE ELECTRON LASER, as a potential mode of electron acceleration, is being pursued at Brookhaven National Laboratory. Recent studies have focussed on the development of a low energy, high gradient, multi stage linear accelerator. The elementary ingredients for the IFEL interaction are the 50 MeV Linac e^- beam and the 10^{11} Watt CO_2 laser beam of BNL's Accelerator Test Facility (ATF), Center for Accelerator Physics (CAP) and a wiggler. The latter element is designed as a fast excitation unit making use of alternating stacks of Vanadium Permendur (VaP) ferromagnetic laminations, periodically interspersed with conductive, nonmagnetic laminations, which act as eddy current induced field reflectors. Wiggler parameters and field distribution data will be presented for a prototype wiggler in a constant period and in a $\sim$ 1.5 %/cm tapered period configuration. The CO_2 laser beam will be transported through the IFEL interaction region by means of a low loss, dielectric coated, rectangular waveguide. Short waveguide test sections have been constructed and have been tested using a low power cw CO_2 laser. Preliminary results of guide attenuation and mode selectivity will be given, together with a discussion of the optical issues for the IFEL accelerator. The IFEL design is supported by the development and use of 1D and 3D simulation programs. The results of simulation computations, including also wiggler errors, for a single module accelerator and for a multi-module accelerator will be presented.

3971 (GSI–92-25(prepr.)) **GSI papers presented at the 3. European particle accelerator conference.** Gesellschaft fuer Schwerionenforschung mbH, Darmstadt (Germany). Apr 1992. vp. (CONF-920315–: 3. European particle accelerator conference (EPAC-3): Accelerators for special applications, Berlin (Germany), 24-28 Mar 1992). Order Number DE93728960. Source: OSTI; NTIS (US Sales Only); INIS.

This report contains the articles presented by the GSI at the named conference. These concern an ion source for heavy ion synchrotron injection, a power amplifier, the new heavy ion injector of the UNILAC, the heavy ion synchrotron SIS, beam intensity measurements at the SIS, heavy ion storage rings, the performance and impedances and instability studies at the ESR, longitudinal space-charge effects in cooled bunched beams, the ERS electron cooling device, experiments with synthetic colored noise at the ESR, ion beams for heavy ion fusion research, a reactor driver concept for indirect drive, plasma lenses for heavy-ion beam focusing, synchrotrons for cancer therapy, and future accelerator projects in collaboration with industry. (orig.).

3972 (INP–1506/PL) **Start-up of isochronous cyclotron AIC-144 Sigma on internal beam.** Schwabe, J. (and others); Brzezicka, B.; Bochenek, R. Institute of Nuclear Physics, Cracow (Poland). 1990. 14p. (In Polish). Order Number DE93607607. Source: OSTI; NTIS (US Sales Only); INIS.

The building of AIC-144 Sigma cyclotron was finished in April 1987. The works on beam optimization were carried out in 1988 and 1989. The main results of these works are given together with technical parameters obtained during the start-up. (A.S.).

3973 (PNL–8372) **Evaluation of S-101 course "Supervisors' Orientation to Occupational Safety in DOE" taught in Stanford, California, July 28, 1992–July 31, 1992.** Wright, T.S. Pacific Northwest Lab., Richland, WA (United States). Oct 1992. 18p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE93002954. Source: OSTI; NTIS; GPO Dep.

This report summarizes trainee evaluations for the Safety Training Section Course, "Supervisors' Orientation to Occupational Safety in DOE" in Stanford, California. Section 1.1 and 1.2 summarize the quantitative course evaluations that trainees provided upon completion of the course. Appendix A provides a transcript of the trainees' written comments. Numeric Course ratings were generally positive and show that the course material and instruction were very effective. Written comments supported the positive numeric ratings. The course content and knowledge gained by the trainees exceeded most of the students' expectations of the course. Results from the final examination showed that students gained significant koowledde from the course.

3974 (SLAC-PUB–5928) **The Next Linear Collider Test Accelerator.** Paterson, J.M.; Ruth, R.D.; Adolphsen, C.; Bane, K.L.; Burke, D.L.; Callin, R.S.; Caryotakis, G.; Cassel, R.L.; Clark, S.L.; Deruyter, H.; Fant, K.; Fuller, R.W.; Heifets, S.A.; Hoag, H.A.; Humphrey, R.; Keicher, A.J.; Kheifets, S.; Koontz, R.F.; Lavine, TStanford Linear Accelerator Center, Menlo Park, CA (United States). Sep 1992. 3p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC03-76SF00515. (CONF-920706–39: International conference on high energy accelerators, Hamburg (Germany), 20-24 Jul 1992). Order Number DE93001824. Source: OSTI; NTIS; INIS; GPO Dep.

During the past several years, there has been tremendous progress on the development of the RF system and accelerating structures for a Next Linear Collider (NLC). Developments include high-power klystrons, RF pulse-compression systems and damped/detuned accelerator structures to reduce wakefields. In order to integrate these separate development efforts into an actual X-band accelerator capable of accelerating the electron beams necessary for an NLC, we plan to build an NLC Test Accelerator (NLCTA). The goal of the NLCTA is to bring together all elements of the entire accelerating system by constructing. and reliably operating an engineered model of a high-gradient linac suitable for the NLC. The NLCTA win serve as a test-bed as the design of the NLC evolves and will provide a model upon which a reliable cost estimate can be based. In addition to testing the RF acceleration system, the NLCTA will be able to address many questions related to the dynamics of the beam during acceleration. In this paper, we will report on the status of the design and component development for the NLC Test Accelerator.

3975 (SLAC-PUB–5948) **A 2 to 4 nm high power FEL on the SLAC linac.** Pellegrini, C. (California Univ., Los Angeles, CA (United States). Dept. of Physics); Rosenzweig, J.; Nuhn, H.D.; Pianetta, P.; Tatchyn, R.; Winick, H.; Bane, K.; Morton, P.; Raubenheimer, T.; Seeman, J.; Halbach, K.; Kim, K.J.; Kirz, J. Stanford Linear Accelerator Center, Menlo Park, CA (United States). Sep 1992. 6p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC03-76SF00515. (LBL–32970;CONF-9208142–13: 14. international free electron laser conference, Kobe (Japan), 23-28 Aug 1992). Order Number DE93004091. Source: OSTI; NTIS; INIS; GPO Dep.

We report the results of preliminary studies of a 2 to 4 nm SASE FEL, using a photoinjector to produce the electron beam, and the SLAC linac to accelerate it to an energy up to 10 GeV. Longitudinal bunch compression is used to increases ten fold the peak current to 2.5 kA, while reducing the bunch length to the subpicosecond range. The saturated output power is in the multi-gigawatt range, producing about 10^{14} coherent photons within a bandwidth of about 0.2% rms, in a pulse of several millijoules. At 120Hz repetition rate the average power is about 1 W. The system is optimized for x-ray microscopy in the water window around 2 to 4 nm, and will permit imaging a biological sample in a single subpicosecond pulse.

3976 (SLAC-PUB–5955) **Electron-positron colliders and other accelerator technologies.** Siemann, R.H. Stanford Linear Accelerator Center, Menlo Park, CA (United States). Oct 1992. 11p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC03-76SF00515. (CONF-920837–16: 26. international IUPAP conference on high energy physics, Dallas, TX (United States), 6-12 Aug 1992). Order Number DE93004018. Source: OSTI; NTIS; INIS; GPO Dep.

The accelerator physics and technology of hadron colliders, heavy quark factories, and linear colliders are reviewed. The status and performance of major high energy accelerators are summarized.

3977 (SSCL-Preprint–122) **Object-oriented simulation for the Superconducting Super Collider.** Zhou, J. Superconducting Super Collider Lab., Dallas, TX (United States). Jun 1992. 18p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC35-89ER40486. (CONF-930113–1: Object oriented simulation conference, San Diego, CA (United States), 17-20 Jan 1993). Order Number DE92015962. Source: OSTI; NTIS; INIS; GPO Dep.

This paper describes the design and implementation of an object-oriented simulation environment called OZ for the Superconducting Super Collider (SSC). The design applies object-oriented technology to data visualization, behavior modelling, dynamic simulation and version control. A meta class structure is proposed to model different types of objects in large systems by their functionality. OZ provides a direct-manipulation user interface which allows the user to visualize the data as an object in the database and interactively model the component of the system. Modelling can be exercised at different levels of the class hierarchy and then can be dynamically bound into a system for simulation. Inheritance is used to derive new configurations of the system or subsystem from the existing one, and specify an object's behavior. Delegation is used to construct a system by instantiating existing objects and "stealing" their methods by delegators. The implementation uses C++, GLISTK library, InterViews 2.6, ISTK library, GNU C++ library, GLISH event sequencer, NIH class library, and ObjectStore.

4302 Beam Dynamics, Field Calculations, and Ion Optics

Refer also to citation(s) 3989, 3994, 3997, 4007, 4011

3978 (FNAL/C–92/241) **SSC collider dipole magnets field angle data.** Kuchnir, M. (Fermi National Accelerator Lab., Batavia, IL (United States)); Bleadon, M.; Schmidt, E.; Bossert, R.; Carson, J.; Delchamps, S.W.; Gourlay, S.; Hanft, R.; Koska, W.; Lamm, M.J.; Mazur, P.O.; Orris, D.; Ozelis, J.; Strait, J.; Wake, M.; DiMarcoFermi National Accelerator Lab., Batavia, IL (United States). Sep 1992. 4p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC02-76CH03000. (CONF-920706–41: International conference on high energy accelerators, Hamburg (Germany), 20-24 Jul 1992). Order Number DE93001952. Source: OSTI; NTIS; INIS; GPO Dep.

In the fabrication of both 40 and 50 mm collider dipole superconducting magnets, surveys of the direction of the magnetic field along their length have been taken. This data besides being used for certifying compliance with the specifications for the finished magnet, yields interesting information on the straightness and rigidity of the coil placement between some stages in their manufacture and testing. A discussion on the measuring equipment and procedures is given. All of the 40 mm magnets that were built or cryostat at Fermilab have at least one of these surveys, and a summary of the data on them is presented. Most of the 50 mm magnets built and cold tested at Fermilab have been surveyed before and after insertion in the cryostat and before and after being cold tested. A summary of this data is also presented.

3979 (KIYal–91-6) **Problems of neutron accelerating tubes "SAPR" construction using modern electronic computers.** Gul'ko, V.M.; Gusarov, V.N.; Izmajlov, A.V.; Kolomiets, N.F.; Mikhajlenko, B.V.; Shikanov, A.E.; Yakovlev, K.I. AN Ukrainskoj SSR, Kiev (Ukraine). Inst. Yadernykh Issledovanij. 1991. 25p. (In Russian). Order Number DE93607611. Source: OSTI; NTIS (US Sales Only); INIS.

The results of the work on creating the pack of applied programmes for calculating the ion-optical system of accelerating neutron tubes are given. The basis of the pack is constituted by the programmes of calculating of electromagnetic fields in the ion-optical systems made by the method of singular integral equations, particle dynamics in the static electromagnetic fields, static simulation of distribution of space charge of the accelerated particles, calculation of neutron flux produced by tube target. The pack contains a number of service programmes providing variation of electrode structure and target parameters, conditions of injection etc., and output service programmes. 6 refs.; 9 figs. (author).

3980 (KIYal–91-11) **The formation and diagnostics of a beam in correlation and neutron experiments.** Zerkyin, V.V.; Konfederatenko, V.Yi.; Povoroznik, O.M.; Struzhko, B.G.; Shidlik, A.M. AN Ukrainskoj SSR, Kiev (Ukraine). Inst. Yadernykh Issledovanij. 1991. 10p. (In Ukrainian). Order Number DE93607610. Source: OSTI; NTIS (US Sales Only); INIS.

The description of diagnostics and beam formation system, that is used in experiments of spectra of triple coincidence of four-particle ^{2}H(d,ppn)n reaction (kinematic full experiment) is presented in the paper. The setup allows to make measurements of cyclotron beam energy by time-of-flight method, of effective on-off ratio and to control the geometrical beam sizes. 2 refs.; 3 figs. (author).

3981 (SLAC–405) **International workshop on final focus and interaction regions of next generation linear colliders: Proceedings.** Stanford Linear Accelerator Center, Menlo Park, CA (United States). [1992]. 380p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC03-76SF00515. (CONF-9205260–: International workshop on final focus and interaction regions of next generation linear colliders, Stanford, CA (United States), 2-6 May 1992). Order Number DE93002517. Source: OSTI; NTIS; INIS; GPO Dep.

The first day of the workshop was devoted to four plenary "issues" talks, one for each working group: Beam-Beam Interaction, Detector, Hardware, and Optical Design. The last day was devoted to plenary talks summarizing the activities of the working groups. Each of the three remaining days there,was a short morning plenary devoted to a brief summary of the preceding day and an announcement of planned working group discussions for that day. The transparencies for the "issues" and "summary" talks are included in this volume, along with some remarks from the working group chairpersons. Very briefly, the beam-beam group continued to address the quantitative study of QED induced backgrounds, and attempted to better understand the nature and prevalence of QCD millijets. The detector group attempted to identify the impact on masking and detector design of the beam-beam backgrounds, the synchrotron radiation induced backgrounds from beam halos and muon backgrounds produced primarily in collimators. Nanosecond timing elements needed in conjunction with multi-bunch operation were discussed. The hardware group addressed the problem of magnet design and support, especially the final doublet magnets suspended within the detector environment, and instrumentation issues, such as high resolution beam position monitors. The optics group discussed new final focus system ideas, collimator design, and improvement of beamline tolerances. If you were not here to participate, we hope that this volume will help you in your orientation to these problems.

3982 (SSCL-Preprint–150) **Constant of motion, Hamiltonian, and Lagrangian for autonomous systems defined in a hyperbolic flat space.** Lopez, G. Superconducting Super Collider Lab., Dallas, TX (United States). Sep 1992. 10p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC35-89ER40486. Order Number DE93002046. Source: OSTI; NTIS; INIS; GPO Dep.

The Lagrangian, the Hamiltonian, and the Generalized Linear Momentum of an autonomous dynamical system defined in a hyperbolic flat space are studied in terms of a constant of motion associated with this system. Some restrictions in the symmetry of the Lagrangian are required in order for the Euler-Lagrange equations to be satisfied. The one-dimensional relativistic motion is given as an example of the approach.

4303 Auxiliaries and Components

Refer also to citation(s) 2857, 3971, 3978, 3981, 4016, 4018, 4021, 4040, 4042, 4473, 4572, 4820

3983 (ANL/APS/TB–2) **Use of a mirror as the first optical component for an undulator beamline at the APS.** Yun, W.; Khounsary, A.; Lai, B.; Gluskin, E. Argonne National Lab., IL (United States). Sep 1992. 12p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-31109-ENG-38. Order Number DE93001338. Source: OSTI; NTIS; INIS; GPO Dep.

In the design of Sector II of the Synchrotron Radiation Instrumentation (SRI) CAT, an x-ray mirror with multiple coatings is chosen as the first optical component of the undulator beamline. Two significant advantages of using the mirror are: A significant reduction in the peak radiation heat flux and total power on the downstream monochromator, and (2) availability of the wide-bandpass undulator spectrum between 0–30 key to experimental

stations with substantially reduced radiation shielding requirements. The second advantage also allows us to place the monochromator outside the first optics enclosure (FOE) at a large distance from the source to further reduce the peak heat flux on the monochromator. The combined effect is that the inclined crystal monochromator may not be necessary, and a multilayer monochromator can be used because the expected heat fluxes are less than the value that has been demonstrated for those monochromators.

3984 (ANL/CP–76107) **Charged-particle beam diagnostics for the Advanced Photon Source (APS).** Lumpkin, A.H.; Decker, G.; Kahana, E.; Patterson, D.; Sellyey, W.; Wang, X.; Chung, Y. Argonne National Lab., IL (United States). [1992]. 17p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-31109-ENG-38. (CONF-9208142–7: 14. international free electron laser conference, Kobe (Japan), 23-28 Aug 1992). Order Number DE93001855. Source: OSTI; NTIS; INIS; GPO Dep.

Plans, prototypes, and initial test results for the charged-particle beam (e^-, e^+) diagnostic systems on the injector rings, their transport lines, and the storage ring for the Advanced Photon Source (APS) are presented. The APS will be a synchrotron radiation user facility with one of the world's brightest x-ray sources in the 10-keV to 100-keV regime. Its 200-MeV electron linac, 450-MeV positron linac, positron accumulator ring, 7-GeV booster synchrotron, 7-GeV storage ring, and undulator test lines will also demand the development and demonstration of key particle-beam characterization techniques over a wide range of parameter space. Some of these parameter values overlap or approach those projected for fourth generation light sources (linac-driven FELs and high brightness storage rings) as described at a recent workshop. Initial results from the diagnostics prototypes on the linac test stand operating at 45-MeV include current monitor data, beam loss monitor data, and video digitization using VME architecture.

3985 (ANL/CP–77394) **Simulated high heat load performance of an inclined crystal monochromator.** Macrander, A.T.; Khounsary, A.M.; Graham, M. Argonne National Lab., IL (United States). Sep 1992. 13p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-31109-ENG-38. (CONF-920792–34: Society of Photo-Optical Instrumentation Engineers (SPIE) international symposium on optical applied science and engineering, San Diego, CA (United States), 19-24 Jul 1992). Order Number DE93000506. Source: OSTI; NTIS; INIS; GPO Dep.

Thermal distortions of an inclined silicon crystal subjected to the high heat loads expected for a 2.5 m long undulator at the Advanced Photon Source were simulated, and the distortions were then used to calculate (111),(111) (+,–) double crystal rocking curves. The inclination angle for all the simulations was either 80° or 85°. The first crystal was assumed to be a slab that was uniformly cooled on its underside with liquid gallium. For some of the simulations, the undulator gap was set to 11.5 mm corresponding to K=2.2, and the crystals were oriented to diffract the first harmonic energy at 4.2 keV. For K=2.2, the total x-ray power incident on the crystal is 3.8 kW , and the peak power density transverse to the beam is 148 W/mm^2. Rocking curve broadening in these cases was found to be no more than 0.42 arcsec. Simulations for the third harmonic at K=2.2 were also performed, and the broadening was found to be no more than 1.87 arcsec. In other simulations the undulator gap was widened, and rocking curves for the third harmonic at K=1.5 (19.9 key) and the first harmonic at K=1.2 (8.2 keV) were obtained. Only weak broadening was found for these cases as well. Finally, rocking curves at 4.2 keV were not altered if a slit that passed only the central cone of the undulator was placed in front of the first crystal.

3986 (BNL–47102) **Design and performance of the Booster Beam Position Monitor system.** Ciardullo, D.J.; Abola, A.; Beadle, E.; Brennan, J.M.; Smith, G.A.; Thomas, R.; Van Zwienen, W.; Warkentien, R.; Witkover, R.L. Brookhaven National Lab., Upton, NY (United States). [1992]. 4p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC02-76CH00016. (CONF-920706–40: International conference on high energy accelerators, Hamburg (Germany), 20-24 Jul 1992). Order Number DE93001971. Source: OSTI; NTIS; INIS; GPO Dep.

Instrumentation has bean built to measure heavy ion and proton beam orbits over an intensity range of 2×10^{10} to 1.5×10^{13} particles per pulse. Twenty-two horizontal and 24 vertical pairs of electrostatic Pickup Electrodes (PUEs), each with a built-in test port, are interfaced with wideband, gain selectable front end electronics. The resulting real-time signals are linearly related (both in amplitude and temporal response) to the sum and difference of the charge induced on each electrode due to passing beam. PUE signals (or their sum and difference) are available at any detector location for use by other Booster systems e.g., the Tune Meter, Transverse Damper, Radial loop control, etc. Data acquistion electronics at each, location integrate the processed front end signals over a selectable number of bunches, then digitize and transmit the integrated sum and difference to the host computer. Data normalization is done in the software, which also provides various orbit acquisition and display options to the user. This paper will describe the Booster Beam Position Monitor system, its performance objectives and the key design aspect used to meet these objectives. In addition, initial results will be presented.

3987 (BNL–47602) **Time dependent magnetization effects in superconducting accelerator magnets.** Ghosh, A.K.; Robins, K.E.; Sampson, W. Brookhaven National Lab., Upton, NY (United States). [1992]. 3p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC02-76CH00016. (CONF-920706–43: International conference on high energy accelerators, Hamburg (Germany), 20-24 Jul 1992). Order Number DE93002322. Source: OSTI; NTIS; INIS; GPO Dep.

The long time drift of the sextupole harmonic b_2, at injection fields is a common feature of superconducting accelerator magnets and, as yet, is not well understood. Measurements of the magnetization decay of superconducting wires and cables show that the normal magnetization decay is not the primary source of the large b_2 drift observed in magnets. Along with this phenomena has been the recent observation of an axial variation in b_2 of accelerator dipoles. This periodic variation in the field along the axis has been observed in a large number of SSC, RHIC and other superconducting dipoles. In all cases the periodicity of the variation matches the lay pitch of the cables used in the magnets. The time dependence of the development and the decay of these field variations has been examined, and found to vary from magnet to magnet. Non-uniform current distribution in the strands of the cable appear to be the cause of this axial variation and may also be responsible for the observed b_2 drift. Details of these measurements and sources for the non-uniform current distribution are discussed in this paper.

3988 (BNL–47620) **The characterization and selection of superconductor wire and cable for RHIC.** Greene, A.F.; Garber, M.; Ghosh, A.K.; McChesney, D.; Morgillo, A. Brookhaven National Lab., Upton, NY (United States). [1992]. 4p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC02-76CH00016. (CONF-920706–44: International conference on high energy accelerators, Hamburg (Germany), 20-24 Jul 1992). Order Number DE93002321. Source: OSTI; NTIS; INIS; GPO Dep.

This report describes the procedures used to select a single vendor for superconductor cable for the RHIC 80 mm dipole and quadrupole magnets, and some insertion dipoles with 110 mm aperture. Experience gained at BNL through involvement with the HERA and SSC Projects provided valuable Teaming experiences for this work. A performance specification was prepared and three qualified vendors were selected to complete a preproduction lot of 63,000 ft. of cable (approximately five multifilament billets). Samples were sent to BNL from every wire spool and from every continuous cable length. Mechanical, electrical and magnetization measurements were made to characterize the material. A data base was used to collect information, to compare BNL and vendor measurements and to study uniformity. Results are presented without specific identification of the vendors involved.

3989 (BNL–47928) **Fast excitation wiggler field measurement results.** Armendariz, J.; Gallardo, J.; Romano, T.; van Steenbergen, A. Brookhaven National Lab., Upton, NY (United States). Aug 1992. 23p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC02-76CH00016. Order Number DE93002327. Source: OSTI; NTIS; INIS; GPO Dep.

As part of the program of Inverse Free Electron Laser (IFEL) Accelerator Development, the development of fast excitation, planar wigglers with high K magnitude has been pursued. This paper discusses the observed characteristics of a variable period length, tapered, wiggler as well as the procedures of measurement. The behaviour of a constant period length magnet with varying Vanadium Permendur (VaP) and field reflector thickness is also discussed.

3990 (BNL–47942) **Quench performance of six similar 17 m-long, 40 mm-aperture SSC model dipoles.** Wanderer, P.; Willen, E. Brookhaven National Lab., Upton, NY (United States). [1992]. 7p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC02-76CH00016. (CONF-920331–59: International industrial symposium on the super collider, New Orleans, LA (United States), 4-6 Mar 1992). Order Number DE93001965. Source: OSTI; NTIS; INIS; GPO Dep.

The quench performance of the final six 17 m-long, 40 mm-aperture SSC model dipoles made at Brookhaven National Laboratory is presented in summary form. The six magnets are of similar construction, except for two features (1) the copper-to-superconductor ratio of the inner cable (either 1.3:1 or 1.5:1) and (2) the axial Preload at 4.35K. The inner coil quench performance does not appear to be correlated with the copper-to-superconductor ratio. There does appear to be a correlation between the outer coil quench performance and the cold axial preload.

3991 (BNL–47964) **Analysis of the superconducting wiggler magnets for the ATF Harmonic Generation FEL experiment.** Zhang, X.; Ben-Zvi, I.; Ingold, G.; Krinsky, S.; Yu, L.H. Brookhaven National Lab., Upton, NY (United States). [1992]. 18p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC02-76CH00016. (CONF-9208142–6: 14. international free electron laser conference, Kobe (Japan), 23-28 Aug 1992). Order Number DE93001974. Source: OSTI; NTIS; INIS; GPO Dep.

In this paper, we consider the superconducting wiggler magnet under construction for the High Gain Harmonic Generation experiment (HGHG) at the Accelerator Test Facility (ATF) at BNL. This wiggler consists of an energy modulation section, a dispersion magnet and a radiator section. We present an analysis of the dispersion magnet and the end effects in the other wiggler sections. The purpose of the dispersion magnet is to convert energy modulation of the electron beam into spatial bunching. For the dispersion magnet, we discuss the physical requirements, analyze the magnetic design, determine the focusing properties, and consider the effect of departures from ideal behavior on the FEL gain. In the modulator and radiator wigglers we analyze the effects due to the ends of the wiggler and discuss their correction. In addition, the localized field produced by a trim coil for horizontal beam steering is investigated.

3992 (BNL–47970) **Laser diagnostics for picosecond e-beams.** Pogorelsky, I. (STI Optronics, Bellevue, WA (United States)); Ben-Zvi, I. Brookhaven National Lab., Upton, NY (United States). [1992]. 6p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC02-76CH00016 ;AC06-83ER40128. (CONF-9206193–15: Advanced accelerator concepts workshop, Port Jefferson, NY (United States), 14-20 Jun 1992). Order Number DE93001972. Source: OSTI; NTIS; INIS; GPO Dep.

We propose a novel approach to picosecond e-bunch/laser pulse synchronization and spatial alignment based upon refraction and reflection of a laser beam on a plasma column created by relativistic electrons traveling through a gas or solid optical material. The technique may be used in laser accelerators and for general subpicosecond e-beam diagnostics.

3993 (BNL–48004) **Photoemission from Ag, Cu, and CsI.** Srinivasan-Rao, T.; Fischer, J.; Tsang, T. Brookhaven National Lab., Upton, NY (United States). Jun 1992. 12p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC02-76CH00016. (CONF-9206193–16: Advanced accelerator concepts workshop, Port Jefferson, NY (United States), 14-20 Jun 1992). Order Number DE93001964. Source: OSTI; NTIS; INIS; GPO Dep.

Photoemission characteristics of three different cathodes, CsI, Ag film and Cu were investigated. CsI, upon irradiation by 213 nm, 10ps laser pulse yields a quantum efficiency of 4% at O.2μJ input energy. The saturation mechanism observed at higher input energies require further investigation. Ag film, upon irradiation by 630 nm, 300 fs laser emit prompt photoelectrons after absorbing 2 photons. There was no evidence of optical damage of the film up to 10^{11} W/cm^2. At low intensities, photoemission from Cu is a simple ν-e^- interaction, the nonlinearity of the process depending strongly on trace impurities. At higher intensities, there appears to be a change in the emission mechanism.

3994 (BNL–48033) **Synchrotron radiation sources and condensers for projection x-ray lithography.** Murphy, J.B. (Brookhaven National Lab., Upton, NY (United States)); MacDowell, A.A.; White, D.L.; Wood, O.R. II. Brookhaven National Lab., Upton, NY (United States). [1992]. 29p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC02-76CH00016. (CONF-9204120–4: Soft-x-ray projection lithography topical meeting, Monterey, CA (United States), 6-8 Apr 1992). Order Number DE93002964. Source: OSTI; NTIS; INIS; GPO Dep.

The design requirements for a compact electron storage ring that could be used as a soft x-ray source for projection lithography are discussed. The design concepts of the x-ray optics that are required to collect and condition the radiation in divergence, uniformity and direction to properly illuminate the mask and the particular x-ray projection camera used are discussed. Preliminary designs for an entire soft x-ray projection lithography system using an electron storage ring as a soft X-ray source are presented. It is shown that by combining the existing technology of storage rings with large collection angle condensers, a powerful and reliable source of 130Å photons for production line projection x-ray lithography is possible.

3995 (BNL–48048) **Design studies on the RHIC position monitor system.** Shea, T. Brookhaven National Lab., Upton, NY (United States). Sep 1992. 13p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC02-76CH00016. (AD/RHIC–114). Order Number DE93001439. Source: OSTI; NTIS; INIS; GPO Dep.

The Relativistic Heavy Ion Collider (RHIC) under construction at Brookhaven National Laboratory will consist of two superconducting storage rings 3.8 km in circumference sharing one tunnel in a side by side configuration. After injection from the existing AGS, the collider will accelerate and store a range of ion species extending from protons through gold to energies of 250 GeV for protons and 100 GeV/nucleon for fully stripped gold ions. Storage times should exceed 10 hours. As in most modern colliders the RHIC beam position monitor system is the most extensive beam diagnostic in terms of both cost and channel multiplicity. The final system will consist of approximately 500 position monitors with over 600 measurement planes of electronics. Development of this system began early so that the monitors would be available for installation into the magnet cryostats. The following document summarizes some of the efforts undertaken during the design phase of this system. Because much of this work is still in progress, the document is necessarily incomplete and some details may not reflect the final system configuration.

3996 (FNAL/C–92/238) **Ac loss measurement of SSC dipole magnets.** Delchamps, S.; Hanft, R.; Jaffery, T.; Kinney, W.; Koska, W.; Lamm, M.J.; Mazur, P.O.; Orris, D.; Ozelis, J.P.; Strait, J.; Wake, M. Fermi National Accelerator Lab., Batavia, IL (United States). Sep 1992. 5p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC02-76CH03000. (CONF-9206281–3: ICFA workshop on AC superconductivity, Tsukuba (Japan), 23-25 Jun 1992). Order Number DE93001950. Source: OSTI; NTIS; INIS; GPO Dep.

AC losses in full length and 1.5 m model SSC collider dipoles were successfully measured by the direct observation of energy flow into and out of magnets during a ramp cycle. The measurement was performed by using two double-integrating type digital volt meters (DVM's) for current and voltage measurement. Measurements were performed for six is m long ASST magnets and five 1.5 m long model magnets, inducting one 40 mm diameter magnet. There were large variations in the eddy current losses. Since these magnets use conductors with slight deviations in their internal structures and processing of the copper surface depending on the manufacturer, it is likely that there are differences in the

contact resistance between strands. Correlation between the ramp rate dependence of the,quench current and the eddy current loss was evident.

3997 (FNAL/C–92/240) **Magnetic field measurements of full length 50 mm aperture SSC dipole magnets at Fermilab.** Strait, J. (Fermi National Accelerator Lab., Batavia, IL (United States)); Bossert, R.; Carson, J.; Delchamps, S.W.; Gourlay, S.; Hanft, R.; Koska, W.; Kuchnir, M.; Lamm, M.J.; Mazur, P.O.; Mokhtarani, A.; Orris, D.; Ozelis, J.; Wake, M.; Devred, A.; DiMarFermi National Accelerator Lab., Batavia, IL (United States). Sep 1992. 4p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC02-76CH03000. (CONF-920706–42: International conference on high energy accelerators, Hamburg (Germany), 20-24 Jul 1992). Order Number DE93001951. Source: OSTI; NTIS; INIS; GPO Dep.

Thirteen 16 m long, 50 mm aperture SSC dipole magnets, designed jointly by Fermilab, Brookhaven National Laboratory, Lawrence Berkeley Laboratory and the SSC Laboratory, have been built at Fermilab. The first nine magnets have been fully tested to date. The allowed harmonics are systematically shifted from zero by amounts larger than the specification. The unallowed harmonics, with the exception of the skew sextupole, are consistent with zero. The magnet-to-magnet RMS variation of all harmonics is much smaller than the specification.

3998 (FNAL-TM–1797) **Antiproton accumulator in the Main Injector era.** Visnjic, V. Fermi National Accelerator Lab., Batavia, IL (United States). Sep 1992. 13p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC02-76CH03000. Order Number DE93003115. Source: OSTI; NTIS; INIS; GPO Dep.

I propose a new lattice for Fermilab Antiproton Accumulator. The lattice is designed with the aim of implementing higher bandwidth stochastic cooling systems, thus enabling the Accumulator to handle antiproton beam intensities expected in the Main Injector era. The design proposed here satisfies very well all the requirements for the new Accumulator concerning the lattice functions, stochastic cooling parameters, and the tunability of the machine.

3999 (INIS-mf–13375, pp. 50) **Neutron yield produced via 150 KeV mixed and atomic deuteron beans from thick Ti-T targets.** Hurani, S.Y.; Morozov, A.V.; Wanis, B.M.; Tahha, H.M. Tajoura Nuclear Research Centre, Tripoli (Libyan Arab Jamahiriya). 1984. 82p. (CONF-8409421–: Seminar on the use of research reactors in fundamental and applied sciences, Tajoura (Libyan Arab Jamahiriya), 16 Sep 1984). In *Seminar on the use of research reactors in fundamental and applied sciences. Programme and abstracts.* Order Number DE93606515. Source: Also available from Tajoura Nuclear Research Centre, Tajoura/Tripoli, Libya.

Short communication. NEUTRON GENERATORS/neutron flux; ATOMIC BEAMS; BEAM BENDING MAGNETS; DEUTERON BEAMS; TITANIUM; TRITIUM TARGET

4000 (INP–1530/PL) **High-voltage feeders for beam extraction system of AIC-144 cyclotron.** Daniel, K.; Korecki, J. Institute of Nuclear Physics, Cracow (Poland). Jul 1990. 14p. (In Polish). Order Number DE93607618. Source: OSTI; NTIS (US Sales Only); INIS.

The main parameters of feeder are given. Its construction is described in detail. The schemes are presented. (A.S.).

4001 (IYaF–91-70) **Low aperture magnetic elements measurements.** Aleksandrov, V.A.; Mikhajlichenko, A.A.; Parkhomchuk, V.V.; Seryj, A.A.; Shil'tsev, V.D. AN SSSR, Novosibirsk (Russian Federation). Inst. Yadernoj Fiziki. 1991. 11p. Order Number DE93605897. Source: OSTI; NTIS (US Sales Only); INIS.

Two new methods of magnetic field measurements in low aperture elements are discussed. The first method uses thin magnetoresistive bismuth wire and the second-strained wire with AC. Principles of measuring used in the last technique are different from well known SLAC method of vibrating wire. Results of testing 0.38 T/mm quadrupole and VLEPP final focus test 3 T/mm lens are presented. Brief comparing of the lens axis determination precision of these methods is also discussed. 4 refs.; 8 figs.

4002 (KIYal–91-10) **Operation system of polarization experiments for accelerators.** Zaika, N.I.; Ofengenden, R.G.; Tokarev, V.P.; Shchur, A.M. AN Ukrainskoj SSR, Kiev (Ukraine). Inst. Yadernykh Issledovanij. 1991. 20p. (In Russian). Order Number DE93607623. Source: OSTI; NTIS (US Sales Only); INIS.

A multi-functional block of intercommunicational system to operate regimes of functioning of the polarized particle source, the accelerator and the storage system has been worked out and manufactured. Tuning has been made, capacity for work and practical capability of employment the block for experiments in nuclear physics has been verified. 5 refs.; 7 figs.; 2 tabs. (author).

4003 (LA-UR–92-2720) **Power coupler and cold window for seven-cell superconducting cavity vertical tests.** Gray, E.R.; Spalek, G. Los Alamos National Lab., NM (United States). [1992]. 4p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. (CONF-9208109–63: 16. international LINAC conference, Ottawa (Canada), 23-28 Aug 1992). Order Number DE93000791. Source: OSTI; NTIS; INIS; GPO Dep.

For tests of the LANL 805MHz seven cell superconducting cavity, we are developing a variable coaxial rf power coupler. Its Q_{ext} will be variable over a range from 10^5 to 10^{12}. It will operate nominally at 3kW CW and lOOkW peak for high power processing. The coupler consists of a 3 inch driveline and window, a 3.45 inch T supported by a $\lambda/4$ shorted stub followed by a step transition to a 2 inch coupler port. A $\sim$ 6.6 Ohm impedance choke joint located at the step transition allows the large center conductor travel necessary for the Q_{ext} variation. The folded choke joint is located at a standing wave current node to keep its excitation below the multipacting level even at high power levels. A low contact-pressure sliding rf seal prevents arcing at the choke joints current node during its filling time.

4004 (LBL–32560) **Advancements in one-dimensional profiling with a long trace profiler.** Irick, S.C.; McKinney, W.R. Lawrence Berkeley Lab., CA (United States). Jun 1992. 7p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC03-76SF00098. (CONF-9206297–1: International symposium on optical fabric testing and surface evaluation, Tokyo (Japan), 6 Jun 1992). Order Number DE93000566. Source: OSTI; NTIS; GPO Dep.

Over the last several years the long trace profiler (LTP) has been evolving into a sophisticated machine capable of measuring surface profiles of very long dimensions. This report explains improvements, both hardware and software, that have helped to achieve accuracies and ranges in surface profiling that have been unobtainable until now. A comparison made by measuring standard optical surfaces on other instruments corroborates these accuracies.

4005 (LBL–32790) **Quadrupole magnets for the SSC.** Lietzke, A.; Barale, P.; Benjegerdes, R.; Caspi, S.; Cortella, J.; Dell'Orco, D.; Gilbert, W.; Green, M.I.; Mirk, K.; Peters, C.; Scanlan, R.; Taylor, C.E.; Wandesforde, A. Lawrence Berkeley Lab., CA (United States). Aug 1992. 10p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC03-76SF00098. (CONF-920802–27: Applied superconductivity conference, Chicago, IL (United States), 23-28 Aug 1992). Order Number DE93002567. Source: OSTI; NTIS; INIS; GPO Dep.

At LBL, we have designed, constructed, and tested ten models (4-1meter, 6-5meter) of the Superconducting Super Collider (SSC) main-ring 5 meter focusing quadrupole magnet (211Tesla/meter). The results of this program are herein summarized.

4006 **Voltage regulation in linear induction accelerators.** Parsons, W.M. To Dept. of Energy. 19 Mar 1991. USAA patent application 7-671,23. 11p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. Order Number DE93002031. Source: OSTI; NTIS; GPO Dep.

Improvement in voltage regulation in a Linear Induction Accelerator wherein a varistor, such as a metal oxide varistor when it is placed in parallel with the beam accelerating cavity and the magnetic core. The non-linear properties of the varistor result in a more stable voltage across the beam accelerating cavity than with a conventional compensating resistance.

4007 (SAND–92-1841) **Beam transport physics issues for the recirculating linear accelerator.** Shokair, I.R. Sandia National

Labs., Albuquerque, NM (United States). Nov 1992. 37p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-76DP00789. Order Number DE93004022. Source: OSTI; NTIS; INIS; GPO Dep.

The Recirculating Linear Accelerator (RLA) utilizes the Ion Focused Regime (IFR) of beam transport plus a ramped bending field to guide the beam around the curved sections. Several issues of beam transport are considered. Beam transverse perturbations that could result in growth of the ion hose instability are analyzed. It is found that transverse kicks due to bending field errors, energy mismatches and fringe fields are the most important. The scaling of these perturbations with beam and channel parameters is derived. The effect of ramping of the bending field on the preformed plasma channel is then considered. For RLA experimental parameters the effect is found to be very small. For high energies however, in addition to axial heating, it is found that ramping the field causes compression of the plasma channel along the radius of curvature. This compression results in a quasi-equilibrium plasma electron temperature along the field lines which leads to collisionless transport towards the walls. The analysis of compression is done in an approximate way using a single particle picture and the channel expansion is analyzed using an envelope solution which gives a simple expression for the expansion time. This solution is then verified by Buckshot simulations. For a bending field of 2 kG ramped in 2 μ-secs and an argon channel (RLA parameters) we estimate that the channel radius doubling time (along field lines) is of the order of 0.5 μ-secs. Finally the effect of electron impact ionization due to axially heated electrons by the action of the inductive field is estimated. It is found that in Argon gas the electron avalanche time could be as low as 0.5 μ-sec which is smaller than the field ramp time.

4008 (SINS–2087/ZDAJ/PP/B) **H^- Ions production in a discharge plasma and construction of some types of ion sources.** Lorkiewicz, J. Soltan Inst. for Nuclear Studies, Otwock-Swierk (Poland). Jan 1990. 55p. (In Polish). Order Number DE93607616. Source: OSTI; NTIS (US Sales Only); INIS.

The report presents a review of contemporary methods of H^- ions production, with particular emphasis on volume in plasmas. The first part shows the attempts by several authors to analyse theoretically the production of $H^-(D^-)$ ions in the low pressure plasma of a discharge as well as in the Penning-discharge and multicusp ion sources. Several types of volume-production, direct extraction sources are described: PIG-type sources, multicusp (bucket) sources and "sheet plasma" sources. (author).

4009 (SLAC–403) **The use and calibration of the Kern ME5000 Mekometer: Proceedings.** Bell, B. (ed.). Stanford Linear Accelerator Center, Menlo Park, CA (United States). Sep 1992. 86p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC03-76SF00515. (CONF-9206270–: Use and calibration of the Kern ME 5000 mekometer, Stanford, CA (United States), 18-19 Jun 1992). Order Number DE93002628. Source: OSTI; NTIS; GPO Dep.

This report discusses the following about the Kern ME5000 Mekometer, a device used to measure the length of accelerator housings: ME5000 Operation; ME5000 Test Measurements; ME5000 Data Reduction; Variance Component Analysis of Baseline Measurements; ME5000 Results; and Calibration and Use of the Mekometer ME5000 in the Survey of the Channel Tunnel.

4010 (SLAC-PUB–5899) **Superconducting accelerator magnets: A review of their design and training.** Palmer, R.B. (Stanford Linear Accelerator Center, Menlo Park, CA (United States)). Stanford Linear Accelerator Center, Menlo Park, CA (United States). Aug 1992. 7p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC03-76SF00515. (CONF-920837–21: ICHEP-26: 26th International Union of Pure and Applied Physics (IUPAP) conference on high energy physics, Dallas, TX (United States), 6-12 Aug 1992). Order Number DE93004088. Source: OSTI; NTIS; INIS; GPO Dep.

This paper reviews the basic mechanical designs of most of the superconducting magnets developed for high energy hadron accelerators. The training performance of these magnets is compared with an instability factor defined by the square of the current density in the stabilizing copper divided by the surface-to-volume ratio of the strands. A good correlation is observed.

4011 (SLAC-PUB–5919) **Downsampled bunch-by-bunch feedback for PEP II.** Hindi, H.A.; Briggs, D.; Fox, J.; Hosseini, W.; Hutton, A. Stanford Linear Accelerator Center, Menlo Park, CA (United States). Sep 1992. 4p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC03-76SF00515. (CONF-9204126–17: B factories: state of the art in accelerators, detectors, and physics, Stanford, CA (United States), 6-10 Apr 1992). Order Number DE93004090. Source: OSTI; NTIS; INIS; GPO Dep.

The PEP II B Factory requires a feedback system to damp out longitudinal synchrotron oscillations. A time-domain bunch-by-bunch feedback system has been proposed in which each bunch is treated as an oscillator being driven by disturbances from the other bunches. The phase is detected, filtered, and the feedback correction signal is applied by the kicker. Since we are damping energy oscillations using measurements of phase, the required feedback signal must be proportional to the amplitude of the phase oscillations but phase shifted by 90 degrees. This signal must be calculated for each of the 1658 bunches, in parallel. In the original proposal, it was estimated that a farm of approximately 480 digital signal processors (DIPS) would be required to implement the feedback system. However, using the technique of downsampling, this number can be reduced to about 50 DIPS. In what follows, we will briefly explain the basic idea of downsampling and its implementation.

4012 (SLAC-PUB–5950) **A Ti:Sapphire laser for the new polarized electron source.** Frisch, J.; Woods, M.B.; Zolotorev, M. Stanford Linear Accelerator Center, Menlo Park, CA (United States). Oct 1992. 3p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC03-76SF00515. (CONF-9208109–68: 16. international LINAC conference, Ottawa (Canada), 23-28 Aug 1992). Order Number DE93004016. Source: OSTI; NTIS; INIS; GPO Dep.

The SLAC polarized electron source uses a laser driven photo cathode gun. We have developed a Titanium Sapphire laser at SLAC to replace the dye laser currently used for the source. The new laser is designed to operate at wavelengths between 750 and 850 nm while producing 400mJ of energy in 1.6 ns pulses at 120 Hz. Installation on the accelerator is expected in January of 1993.

4013 (SSCL–602) **Limitations of a residual gas ionization beam profile monitor for the SSC Collider.** Meinke, R. (Superconducting Super Collider Lab., Dallas, TX (United States)); Nexsen, W.; Tsyganov, E.; Zinchenko, A. Superconducting Super Collider Lab., Dallas, TX (United States). Nov 1992. 7p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC35-89ER40486. Order Number DE93004390. Source: OSTI; NTIS; INIS; GPO Dep.

A residual gas ionization beam profile monitor for the superconducting Super Collider is considered in detail using the Monte Carlo simulation code. It is shown that a good spatial resolution could be obtained using a combination of strong electrical and magnetic fields.

4304 Storage Rings

Refer also to citation(s) 4676

4014 (BESSY-TB–166/91) **Superconducting synchrotron radiation sources for industrial application.** Weihreter, E. Berliner Elektronenspeicherring-Gesellschaft fuer Synchrotronstrahlung mbH (BESSY), Berlin (Germany). Aug 1991. 16p. (CONF-910921–: 2. European conference on accelerators in applied research and technology, Frankfurt am Main (Germany), 3-7 Sep 1991). Order Number DE93728690. Source: OSTI; NTIS (US Sales Only); INIS.

X-ray lithography and the LIGA-process are promising examples for the application of synchrotron radiation in the field of industrial mass production of microelectronic and micromechanical devices. In addition, k-edge angiography is a candidate for the use of synchrotron radiation in the field of medical diagnostics. To provide the necessary tools for these applications, compact electron storage

rings are under development at many places worldwide. In this paper the basic concepts of superconducting storage rings are reviewed to point out the technical challenges in this field. The achievements made with the first compact sources are presented. (orig.).

4015 (BONN-ME–92-02) **An investigation of the QBA-optics for the storage ring LISA.** Einfeld, D. (Fachhochschule Ostfriesland, Emden (Germany)); Husmann, D.; Plesko, M. Bonn Univ. (Germany). Physikalisches Inst. Aug 1992. 28p. Order Number DE93728870. Source: OSTI; NTIS (US Sales Only); INIS.

A modified QBA-lattice for the synchrotron light source LISA is proposed. The lattice has matching sections for suppressing the dispersion and two unit cells in between. A unit cell consists of one bending magnet with a focusing quadrupole on each side of it. The novel feature of this lattice is the use of horizontally defocusing bending magnets with different angles to keep the radiation integrals small. The bending angle of the unit cell magnets is twice that of the magnets in the matching sections. For a 60deg achromat with 20deg bending angle per unit cell a 2.5 GeV storage ring yields and emittance of 20 π nm rad. Including long straight sections of 4.6 m the circumference of this machine is 124.8 m. The chromaticities and the sextupole strengths are moderate, the dynamic aperture is large and the momentum acceptance is more than $\pm$9%. (orig.).

44 INSTRUMENTATION

4401 Radiation Instrumentation

Refer also to citation(s) 2761, 3562, 3771, 3995, 4104, 4263, 4297, 4298, 4299, 4462, 4468, 4473, 4478, 4542, 4543, 4544, 4546, 4609

4016 (BNL–47904) **Progress in the optoelectronic analog signal transfer for high energy particle detectors.** Tsang, T.; Radeka, V. Brookhaven National Lab., Upton, NY (United States). May 1992. 17p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC02-76CH00016. (CONF-9205210–4: 2. annual conference on electronics for future colliders, Chestnut Ridge, NY (United States), 19-21 May 1992). Order Number DE93001440. Source: OSTI; NTIS; INIS; GPO Dep.

We report the progress in the development of a radiation hard Optoelectronic analog system to transfer particle detector signals with high accuracy. We will present the motivation of this study, the operating principle of the optoelectronic system, the system noise study, the recent R&D efforts on radiation effect, temperature stability, and the realization of an integrated I x I6 optical modulator. The issue of photon source for driving such a large-scale optoelectronic modulators is a major concern. We will address this problem by examining different possible photon sources and comment on other possible alternative for signal transfer.

4017 (BNL–47955) **Area detectors for neutron protein crystallography.** Schoenborn, B.P. Brookhaven National Lab., Upton, NY (United States). [1992]. 8p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC02-76CH00016. (CONF-920792–39: Society of Photo-Optical Instrumentation Engineers (SPIE) international symposium on optical applied science and engineering, San Diego, CA (United States), 19-24 Jul 1992). Order Number DE93001973. Source: OSTI; NTIS; INIS; GPO Dep.

The main problem in neutron protein crystallography is the low flux of present reactor based or pulsed neutron sources. This low flux is however well matched with presently available multiwire area detectors. One way to increase the flux at the sample is to increase the wavelength bandwidth. The conventional technique uses a monochromator with a bandwidth of the order of 1%. This bandwidth can be increased by using a multilayer monochromator composed of different "d" spacings. This provides a large delta lambda increasing the flux manifold. In this case a reflection in diffraction condition is scanned by the wavelength bandwidth and not by rotation of the reciprocal lattice point through the Ewald sphere. In order to collect most of the simultaneous diffraction a large cylindrical area detector covering an angular width of 120° with a height of approximately 20cm is needed. Such a detector should have a spacial resolution of 1.1mm, an efficiency of 80% at 2.0A and a counting rate of one million events per second. This detector will be subdivided into 4 sectors that will be decoded simultaneously into a Motorola based computer system. This data acquisition system allows time slicing and this detector is therefore useful for similar experiments using pulsed neutron sources.

4018 (CONF-9205210–5) **Electronics for the RHIC PHENIX detector.** Young, G.R. Oak Ridge National Lab., TN (United States). [1992]. 12p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. From 2. annual conference on electronics for future colliders; Chestnut Ridge, NY (United States); 19-21 May 1992. Order Number DE93002422. Source: OSTI; NTIS; INIS; GPO Dep.

The PHENIX detector for RHIC is being designed to measure lepton pairs, direct photons and hadrons emitted in collisions of heavy nuclei at center of mass energies up to 200 GeV/(nucleon-pair). The physics goal is tests of predictions concerning the existence and nature of a deconfined state of strongly-interacting matter. The relatively large final state multiplicities, which reach 1500 charged particles per unit of rapidity, place strong demands on detector segmentation and control of electronics cost and power consumption. An overview of present ideas concerning signal processing and data rates for PHENIX will be presented.

4019 (CONF-921046–3) **Tools and techniques for evaluation intercomparison.** Hetrick, D.M. Oak Ridge National Lab., TN (United States). [1992]. 10p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. From Symposium on nuclear data evaluation methodology; Upton, NY (United States); 12-16 Oct 1992. Order Number DE93001643. Source: OSTI; NTIS; INIS; GPO Dep.

A number of computer programs are described that will read the appropriate data format evaluations in ENDF format (V or VI), perform the required calculations, and plot results versus available measured data. These tools are useful in showing weaknesses in evaluations and for uncovering discrepancies. The programs are capable of graphing results for reaction cross sections, differential scattering cross sections, angle- integrated emission spectra, double-differential cross sections of neutron emission, and gamma-ray spectra. Examples are given that illustrate the numerous options presently available.

4020 (CONF-9210194–2) **Monitoring of surface alpha contamination with inexpensive passive monitors.** Gammage, R.B. (Oak Ridge National Lab., TN (United States)); DePriest, J.C.; Wheeler, R.V.; Dempsey, J.C.; Kotrappa, P. Oak Ridge National Lab., TN (United States). [1992]. 5p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. From International symposium on environmental contamination; Budapest (Hungary); 12-16 Oct 1992. Order Number DE93001636. Source: OSTI; NTIS; INIS; GPO Dep.

Field applications are presented in the monitoring of indoor and outdoor surface alpha contamination using passive devices. Both small alpha track and larger electret devices were used. Sensitivity is such that passive measurements made in one to two hours produce 10:1 signal-to-noise readings at a proposed release level of 220 dpm/100 cm^2 (3.7 Bq/cm^2). The small alpha track detectors can be deployed in cracks, under doors, inside narrow pipes and other difficult to access locations where contaminated dirt collects and resists easy removal. Examples are given of the mapping of alpha contamination on floors and metal flanges. Track detectors can also provide spatially resolved information on a fine scale and recognize micron-sized particulate contamination. Soils contaminated with low-level plutonium produce readily measurable voltage drops of 1–5 v/h with 2 g samples containing 5–27 pCi/g, respectively. The electret device has the advantage of allowing readout immediately after exposure using a portable voltmeter. Processing of the exposed plastic track detector requires chemical etching and optical counting to obtain the density of etch tracks but provides a permanent record of an exposure. Both types of devices will find numerous applications in decontamination and decommissioning.

4021 (DOE/ER–0569P) **Report of the DOE Office of Energy Research review committee on the Solenoidal Detector**

Collaboration of the Superconducting Super Collider. USDOE Office of Energy Research, Washington, DC (United States). Office of Superconducting Super Collider. Nov 1992. 185p. Sponsored by USDOE, Washington, DC (United States). Order Number DE93003764. Source: OSTI; NTIS; INIS; GPO Dep.

At the request of Dr. James F. Decker, Deputy Director of DOE's Office of Energy Research, a technical review committee was assembled to perform a peer review of the Solenoidal Detector Collaboration (SDC) from October 26 to October 30, 1992, at the Superconducting Super Collider Laboratory (SSCL). The Energy Research Review Committee (ERC) evaluated the technical feasibility, the estimated cost, the proposed construction schedule, and the management arrangements for the SDC detector as documented in the SDC Technical Design Report, SDC Project Cost/Schedule Summary Book, SDC draft Project Management Plan, and other materials prepared for and presented to the Committee by the SDC management. The SDC detector is one of two major detector facilities anticipated at the SSC. The SDC project will be carried out by a worldwide collaboration of almost 1000 scientists, engineers, and managers from over 100 universities, national laboratories, and industries. The SDC will construct a state-of-the-art, general-purpose detector weighing over 26,000 tons and the size of an eight-story building, to perform a broad class of high energy physics experiments at the SSC beginning in the fall of 1999. The design of the SSC detector emphasizes tracking in a strong solenoidal magnetic field to measure charged-particle momenta and to assist in providing good electron and muon identification; identification of neutrinos and other penetrating particles using a hermetic calorimeter; studies of jets of hadrons using both calorimeter and tracking systems; and studies of short-lived particles, such as B mesons, and pattern recognition within complex events using a silicon-based vertex tracking system. These capabilities are the result of the intensive research, development, and design activities undertaken since 1989 by this very large and capable collaboration.

4022 (DOE/ER/05030–T1) **[Elementary particles]: Final technical report.** Rutgers–the State Univ., New Brunswick, NJ (United States). [1983]. 10p. Sponsored by USDOE, Washington, DC (United States); National Science Foundation, Washington, DC (United States). DOE Contract AS05-78ER05030. Order Number DE93004034. Source: OSTI; NTIS; GPO Dep.

During the period from September 1, 1982 to August 31, 1984, funds totaling $159,414 are requested for analysis of E515 data and continued development of high resolution detectors required in an anticipated beauty experiment. In the Fermilab experiment E515 we have recorded 60,000 pictures with the scintillation camera and hope to reconstruct perhaps 100 charmed particles. We are continuing to develop the MCP vertex detector and are considering several variations of the scintillation camera technique. Two other novel detectors with prospects for high resolving power are currently under development.

4023 (DOE/ER/40310–T2) **Photon detector for MEGA: Progress report, July 16, 1991–May 31, 1992.** Gagliardi, C.A.; Tribble, R.E. Texas A and M Univ., College Station, TX (United States). [1992]. 25p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG05-87ER40310. Order Number DE93004366. Source: OSTI; NTIS; INIS; GPO Dep.

The MEGA photon detector is designed to observe the 52.83-MeV photon produced in a $\mu \rightarrow e\gamma$ decay with an energy resolution of 1.25 MeV, a position resolution of 2×5 mm^2, a directional resolution of 10°, a time resolution of 500 ps, and an efficiency of about 5.4%. It will consist of three independent concentric cylindrical pair spectrometers mounted within a 1.5 T magnetic field produced by a superconducting solenoid magnet. Each pair spectrometer includes two thin Pb foils to convert photons into e^+e^- pairs. The two smaller pair spectrometers will have three drift chamber layers to track the e^+e^- pairs and thereby determine both their locations and their vector momenta. The third pair spectrometer will have four layers of drift chamber, together with a larger turning region, to provide better tracking information for high energy photons. The inner drift chamber layer in each of the spectrometers includes a delay line cathode to determine the z coordinates needed for track reconstruction. An MWPC located between the two Pb layers identifies the conversion layer so that energy loss corrections may be applied, while plastic scintillators provide timing information. During the past year, efforts have focused primarily on software development, completion of the delay line tests, and development of electronics for the scintillators and delay line read-out. Optical windows were glued onto the light guides required for the third pair spectrometer. In addition, major contributions were made to the development of a proposal to measure the Michel parameter, ρ, using the MEGA positron detectors.

4024 (DOE/ER/40323–T6) **[Medium energy meson research].** Crowe, K.M. California Univ., Berkeley, CA (United States). Dept. of Physics. [1992]. 62p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG03-87ER40323. Order Number DE93004133. Source: OSTI; NTIS; INIS; GPO Dep.

The activities of this group are primarily concerned with experiments using the Crystal Barrel Detector. This detector is installed and operating at the Low Energy Antiproton Ring (LEAR) at CERN. QCD, the modern theory of the strong interaction, is reasonably well understood at high energies, but unfortunately, low-energy QCD is still not well understood, and is far from being adequately tested. The Crystal Barrel experiments are designed to provide some of the tests. The basic line of research involves meson spectroscopy, analyses bearing on the quark and/or gluon content of nuclear states, and the exploration of mechanisms and rules which govern $p\bar{p}$ annihilation dynamics. The Crystal Barrel Detector detects and identifies charged and neutral particles with a geometric acceptance close to 100%. The principal component of the detector is an array of 1,380 CsI(Tl) crystals. These crystals surround a Jet Drift Chamber (JDC), located in a 1.5 Tesla magnetic field, which measures the momentum and dE/dx of charged particles. One of the very interesting physics goals of the detector is a search for exotic mesonic states – glueballs and hybrids. Annihilation at rest will be studied with both liquid and gaseous hydrogen targets. The gaseous target offers the possibility of triggering on atomic L-shell X rays so that specific initial angular momentum states can be studied.These topics as well as other related topics are discussed in this report.

4025 (DOE/ER/40544–1) **Workshop on major SSC detectors.** Arizona Univ., Tucson, AZ (United States). 1990. 702p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG02-90ER40544. (CONF-900243–: Workshop on major SSC detectors, Tucson, AZ (United States), 18-23 Feb 1990). Order Number DE93002733. Source: OSTI; NTIS; INIS; GPO Dep.

This report contains notes generated during the workshop.

4026 (DOE/ER/40615–2) **Experimental particle physics: Progress report, September 16, 1991–September 30, 1992.** Steinberg, R.I.; Lane, C.E. Drexel Univ., Philadelphia, PA (United States). Dept. of Physics. Sep 1992. 53p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG02-91ER40615. Order Number DE93003884. Source: OSTI; NTIS; INIS; GPO Dep.

The goals of this research are the experimental testing of fundamental theories of physics beyond the standard model and the exploration of cosmic phenomena through the techniques of particle physics. We are working on the MACRO experiment, which employs a large-area underground detector to search fore grand unification magnetic monopoles and dark matter candidates and to study cosmic ray muons as well as low- and high-energy neutrinos; the Chooz experiment to search for reactor neutrino oscillations at a distance of 1 km from the source; a new proposal (the Perry experiment) to construct a one-kiloton liquid scintillator in the Fairport, Ohio underground facility IMB to study neutrino oscillations with a 13 km baseline; and development of technology for improved liquid scintillators and for very-low-background materials in support of the MACRO and Perry experiments and for new solar neutrino experiments.

4027 (DOE/ER/40653–1) **Development of a scintillating fiber tracker for the SSC: Final technical report, July 1, 1991–June 30, 1992.** Lewis, R.A. Pennsylvania State Univ., University Park, PA (United States). Oct 1992. 7p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG02-91ER40653. Order Number DE93003900. Source: OSTI; NTIS; INIS; GPO Dep.

The Fiber Tracking Group (FTG) of the Solenoidal Detector Collaboration (SDC) is developing a high rate tracking subsystem appropriate for the SDC detector based on scintillating fiber (SciFi) technology. In the past two years a major upgrade in the design was conceived, which reduces the material and cost of the tracker and improves the effectiveness of the tracking system as a trigger element. The results of simulations of the performance of the tracker at Penn State have been very important in keeping the SciFi technology as an attractive option for a tracking system for the SDC collaboration. In the past year an array of scintillating fiber elements has been evaluated in a test beam at Brookhaven. Past experience of Penn State personnel at Brookhaven proved valuable in making the test beam runs a success.

4028 (IAE–2091/R-5/D/A) **Photon interaction probability in a liquid scintillator.** Pochwalski, K. Institute of Atomic Energy, Otwock-Swierk (Poland). Feb 1990. 19p. Order Number DE93607923. Source: OSTI; NTIS (US Sales Only); INIS.

The probability of interaction of 1 keV to 5 MeV photons with a liquid scintillator (toluene/triton X-100/water) of a volume of 0.6 ml in glass vials and 5.3 ml in plastic vials, is presented. The results are shown in the digital and graphical form. (author).

4029 (IAE–2105/OBRI/I/A) **Measurement of ^{125}I K x and 35.5 keV photon emission probabilities.** Kempisty, T. Institute of Atomic Energy, Otwock-Swierk (Poland). Nov 1990. 13p. Order Number DE93607845. Source: OSTI; NTIS (US Sales Only); INIS.

The K x ray and 35.5 keV gamma-ray emission probabilities of ^{125}I has been determined. The photon spectra were measured with HP-Ge detector. The activity of ^{125}I sources were measured by means of x-x, γ coincidence method using of fast-slow coincidence spectrometer. (author).

4030 (INIS-BR–2970) **Tracer technique for measuring specific activity of ^{63} Ni, using $4\pi\beta$-γ.** Iwahara, A. Instituto Militar de Engenharia (IME), Rio de Janeiro, RJ (Brazil). 1979 127p. (In Portuguese). Order Number DE93607924. Source: OSTI; NTIS (US Sales Only); INIS.

The specific activity of a ^{63} Ni solution has been measured by an efficiency tracer technique using a 4 π β - γ coincidence system. ^{63} Ni was chosen. Because it's a very low energy pure beta emitter. Due to chemical compatibility and beta spectral shapes, ^{60} Co has been chosen as tracer. In the determination of ^{63} Ni, the specific activity. As the efficiency tracer techniques requires a previous knowledge of tracer activity, this has been measured by a conventional 4 π β -γ coincidence method. (author).

4031 (INIS-BR–3005) **Construction, calibration and test of an ionization chamber for exposure measurement of x and gamma radiation in region from 40 keV to 1250 keV.** Campos, C.A.A.L. Universidade do Estado, Rio de Janeiro, RJ (Brazil). Centro Biomedico. 1982 162p. (In Portuguese). Order Number DE93607925. Source: OSTI; NTIS (US Sales Only); INIS.

An unsealed thimble ionization chamber with connecting cable was designed, manufactured and tested at the IRD=CNEN, for exposure or exposure rate measurement of X or gamma rays in the energy range from 40 KeV up to Cobalt-60. Recommendations given by IEC, TC-62 (1974) were used as acceptance tests of the ionization chamber for use as a tertiary standard (field class instruments) in radiation therapy. In addition, intercomparison with commercially available chambers of reference class type were carried out in respect to field size dependence, energy dependence, short and long term stability. The results of those tests indicated the usefulness of the developed ionization chamber as a tertiary standard. (author).

4032 (INIS-BR–3019) **Practical use of LIF-Nuclemon as a thermoluminescent dosemeter of γ, χ and β radiations.** Marilac Pereira Dolabela, L. de. Minas Gerais Univ., Belo Horizonte, MG (Brazil). Inst. de Ciencias Exatas. 1987 260p. (In Portuguese). Order Number DE93607834. Source: OSTI; NTIS (US Sales Only); INIS.

The practical use of doped LiF Nuclemon with magnesium (LiF:Mg) as a thermoluminescent dosimeter of γ, X and β radiations is studied. The TL properties of LiF:Mg were analysed to γ energy of 1,25 MeV; 30, 50 and 70 KeV. (author).

4033 (INIS-BR–3045) **Thermoluminescence of LIF: Mg, Ti between 77 and 315 K.** Rosa, L.A.R. da. Sao Paulo Univ., SP (Brazil). Inst. de Fisica. 1989 168p. (In Portuguese). Order Number DE93607835. Source: OSTI; NTIS (US Sales Only); INIS.

A special thermoluminescent system was developed. It is able to operate right from liquid nitrogen temperature and also permits the determination of the sample thermoluminescent emission spectrum. Using this system, the thermoluminescence displayed by 77 K irradiated LiF:Mg,Ti (TLD-100), from the irradiation temperature to 315 K, was studied. In this temperature range seven glow peaks, at 139, 153, 194, 240, 260, 283 and 300 K, were determined. (author).

4034 (INIS-mf–13375, pp. 16) **Thermal neutron scattering spectrometer for the dynamical properties investigations of crystal substances at TRC.** Majdob, M.M.; Shihub, S.I. Tajoura Nuclear Research Centre, Tripoli (Libyan Arab Jamahiriya). 1984. 82p. (CONF-8409421–: Seminar on the use of research reactors in fundamental and applied sciences, Tajoura (Libyan Arab Jamahiriya), 16 Sep 1984). In *Seminar on the use of research reactors in fundamental and applied sciences. Programme and abstracts.* Order Number DE93606515. Source: Also available from Tajoura Nuclear Research Centre, Tajoura/Tripoli, Libya.

Short communication. NEUTRON SPECTROMETERS; MONOCHROMATORS; THERMAL NEUTRONS

4035 (KAERI/RR–1061/91) **The development of application technology for image processing in nuclear facilities.** Lee, Jong Min (Korea Atomic Energy Research Inst., Daeduk (Korea, Republic of)); Lee, Yong Bum; Kim, Woong Ki; Kim, Seung Ho; Kim, Chang Hoe; Kim, Byung Soo; Sohn, Surg Won; Hwang, Suk Yeoung. Korea Atomic Energy Research Inst., Daeduk (Korea, Republic of). Jan 1992. 120p. (In Korean). Order Number DE93605838. Source: OSTI; NTIS (US Sales Only); INIS.

In this study, first, the prototype of the radiation level monitoring system as well as the monitoring algorithms is developed. Secondly, the pattern recognition algorithms are developed for robot vision. As the results of the experiments, the radiation level distribution is surveyed through two dimensional data acquired by the prototype. Also, the number images and bolt images are accurately recognized by the pattern recognition algorithms. It is expected that not only radiation level monitoring system but the pattern recognition algorithms will be adopted to development of the nuclear intelligent robot in the process of being performed in this laboratory. (Author).

4036 (KFK–4999) **New evaluation methods for plutonium assay by passive neutron interrogation of barrels with heavy and heterogeneous waste.** Eyrich, W. (Kernforschungszentrum Karlsruhe GmbH (Germany)); Klotz, W.D.; Simon, G.G. Kernforschungszentrum Karlsruhe GmbH (Germany). Inst. fuer Neutronenphysik und Reaktortechnik; Kernforschungszentrum Karlsruhe GmbH (Germany). Hauptabteilung Ingenieurtechnik; Kernforschungszentrum Karlsruhe GmbH (Germany). Koordinationsstelle Internationale Forschung zur Nuklearen Entsorgung (KNE). Mar 1992. 50p. (In German). (PWA–39/91). Order Number DE93728905. Source: OSTI; NTIS (US Sales Only); INIS.

To detect minute quantities of plutonium in 220 liter drums, a new method and a data analysis system were developed, the LCA (local correlation analysis system). With this, it is possible to determine the exact probe location. It has the ability to distinguish between a homogeneous Pu-distribution and a Pu-probe in the center of the container. Within each neutron signal, the time of pulse and the counter number are registered, therefore analysis methods currently in practice can utilize. For drums having a higher plutonium content the detection efficiency can be determined directly without knowledge of the matrix composition or the probe location. The data analysis system is tailored to be used with an ordinary PC. (orig.).

4037 (LA–12451-MS) **Statistical data filtration in neutron coincidence counting.** Beddingfield, D.H.; Menlove, H.O. Los Alamos National Lab., NM (United States). Nov 1992. 8p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. Order Number DE93001907. Source: OSTI; NTIS; INIS; GPO Dep.

We assessed the effectiveness of statistical data filtration to minimize the contribution of matrix materials in 200-ℓ drums to the nondestructive assay of plutonium. Those matrices were examined: polyethylene, concrete, aluminum, iron, cadmium, and lead. Statistical filtration of neutron coincidence data improved the low-end sensitivity of coincidence counters. Spurious data arising from electrical noise, matrix spallation, and geometric effects were smoothed in a predictable fashion by the statistical filter. The filter effectively lowers the minimum detectable mass limit that can be achieved for plutonium assay using passive neutron coincidence counting.

4038 (NUREG/CR–5868) **Development of position sensitive proportional counters for hot particle detection in laundry and portal monitors.** Shonka, J.J. (Shonka Research Associates, Inc., Marietta, GA (United States)); Schwahn, S.O.; Bennett, T.E.; Misko, D.J. Nuclear Regulatory Commission, Washington, DC (United States). Div. of Regulatory Applications; Shonka Research Associates, Inc., Marietta, GA (United States). Sep 1992. 28p. Sponsored by Nuclear Regulatory Commission, Washington, DC (United States). (SRA–9201). Source: OSTI; NTIS; INIS; GPO.

This report summarizes research which demonstrates the use of position sensitive proportional counters in contamination monitoring systems. Both laundry monitoring and portal monitoring systems were developed. The laundry monitor was deployed at a nuclear power plant where it was used to monitor clothing during an outage. Position sensitive proportional counter based contamination monitoring systems were shown to have significant advantages over systems using conventional proportional counters. These advantages include the ability to directly measure the area and quantity of contamination. This capability permits identification of hot particles. These systems are also capable of self calibration via internal check sources. Systems deployed with this technology should benefit from reduced complexity, cost and maintenance. The inherent reduction of background that occurs when the counter is electronically divided into numerous detectors permits operation in high background radiation fields and improves detection limits over conventional technology.

4039 (SINS–2121/P-6/PH/A) **Analysis of systematic uncertainties in the study of anomalous behaviour of Z-2 nuclear fragments.** Bano, M. (Slovenska Akademia Vied, Kosice (Czechoslovakia). Ustav Experimentalnej Fyziky); Kravcikova, M.; Glagolev, V.V. Soltan Inst. for Nuclear Studies, Otwock-Swierk (Poland). Aug 1991. 7p. Order Number DE93607874. Source: OSTI; NTIS (US Sales Only); INIS.

Report received in March 1992.

The study of possible systematic uncertainties in the evaluation of cross sections of secondary helium nuclei in the hydrogen bubble chamber is presented. It is shown that corrections are negligible. (author).

4040 (SSCL–598) **Test results on current-splitter Version 2 chip.** Yang, W.; Dorenbosch, J.; Kibuule, P. Superconducting Super Collider Lab., Dallas, TX (United States). Oct 1992. 9p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC35-89ER40486. Order Number DE93003330. Source: OSTI; NTIS; INIS; GPO Dep.

We report test results for the second version of the current-splitter chip for the Photo Multiplier Tube (PMT) digital readout system. The chip was designed by Fermilab and fabricated using the Orbit 2 micron BiCMOS process. Version 2 of the splitter has 10 splitting ranges compared to 9 in the previous design. Measurements were done to test the performance of the current-splitter chip at the Physics Research Division, Superconducting Super Collider Laboratory (SSCL).

4041 (SSCL-Preprint–153) **VXIbus Beam Position Monitor module.** Jones, A.A. Superconducting Super Collider Lab., Dallas, TX (United States). Oct 1992. 7p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC35-89ER40486. Order Number DE93001674. Source: OSTI; NTIS; INIS; GPO Dep.

This is a description of a VXIbus Register Based Beam Position Monitor module. This module consists of a sealed analog module that outputs the sum and difference of the log signals for both the X and Y axis of the Beam Position Monitor (BPM). These signals are then digitized by 12-bit analog-to-digital converters. These digitized values are then stored in memory. A selectable number of these digitized values can also be averaged and stored. This will be particularly useful when close orbit information is required.

4042 (SSCL-Preprint–155) **Cosmic ray test of SDC prototype muon drift tubes.** Fukui, T. (Superconducting Super Collider Lab., Dallas, TX (United States)); Lubatti, H.J.; Thunborg, J.; Daly, C.; Davisson, R.; Davisson, W.; Dougherty, W.; Guldenmann, H.; Hersch, J.; Paulson, K.; Zhao, T. Superconducting Super Collider Lab., Dallas, TX (United States). Jun 1992. 6p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC35-89ER40486. (CONF-9206222–3: International conference on advanced technology and particle physics, Como (Italy), 22-26 Jun 1992). Order Number DE93001680. Source: OSTI; NTIS; INIS; GPO Dep.

Preliminary results are presented from cosmic ray tests of the SDC muon detector prototype module. The module consists of 30 drift cells. Each drift cell is a 9m long, 73mm inner diameter aluminum tube with simple field shaping electrodes. The anode wire is gold plated tungsten. The construction of the module makes use of the drift tubes as structural elements. The resolution and efficiency are approximately 200μm and 99%, respectively.

4043 (UCRL-JC–110349) **A working method for treating variations in counting efficiency.** Gunnink, R. Lawrence Livermore National Lab., CA (United States). 1 Sep 1992. 4p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. (CONF-9209233–1: International k_0 users workshop, Gent (Belgium), 30 Sep - 2 oct 1992). Order Number DE93000515. Source: OSTI; NTIS; GPO Dep.

A practical model is described that accurately determines gamma-ray detection efficiencies of germanium detectors as functions of known or measurable parameters, such as the gamma-ray energy, source-to-detector distance, detector dimensions, absorbing materials, and source characteristics (dimensions, weight, and composition). Equations and algorithms based on this model have been written into computer routines to make run-time calculations for detection efficiencies that account for changes in these parameters. A code called EFFIC win be used during the workshop to demonstrate our model.

4402 Radiation Effects On Instrument Components, Instruments, Or Electronic Systems

Refer also to citation(s) 3965

4044 (DESY–92-060) **Radiation hardness of silicon detectors for future colliders.** Fretwurst, E. (Hamburg Univ. (Germany). 1. Inst. fuer Experimentalphysik); Claussen, N.; Croitoru, N.; Lindstroem, G.; Papendick, B.; Pein, U.; Schatz, H.; Schulz, T.; Wunstorf, R. Deutsches Elektronen-Synchrotron (DESY), Hamburg (Germany). Apr 1992. 24p. Contract BMFT 055HH19I. (CONF-9202140–: 6. European symposium on semiconductor detectors: New developments on radiation detectors, Milan (Italy), 24-26 Feb 1992). Order Number DE93728830. Source: OSTI; NTIS (US Sales Only); INIS.

The radiation hardness of silicon pad detectors, especially developed for the PLUG-Calorimeter of the H1 Experiment at HERA was investigated with respect to neutron and electron irradiation. Be(d,n)-neutrons with an average energy of 6.2MeV up to a fluence of 10^{15}n/cm^2 and 1.8MeV electrons up to a dose of 1MGy (10^{16}e/cm^2) were used. Degradation effects of the diode properties regarding the reverse current, depletion voltage and charge collection efficiency are studied at room temperature and with no bias applied during irradiation. Special emphasis is put on the separation of the respective damage generation and its subsequent self annealing. The observed effects are discussed with respect to radiation levels to be envisioned for experiments with future colliding beam machines. (orig.).

4045 **Ringlight for use in high radiation.** Baylor, G.A.; Jacket, H.S. To Dept. of Energy. 6 Mar 1991. USAA patent application 7-665,11. 11p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC11-89PN38014. Order Number DE93002016. Source: OSTI; NTIS; GPO Dep.

The present invention relates generally to ringlight for providing illumination about a central viewing area and more particularly to an improved ringlight design suitable for use in automatic gaging applications conducted in hostile radioactive environments. It is a further object of the present invention to provide a ringlight which is relatively simple in construction and with few parts, and which is thus very reliable in operation. The above and other objects are achieved in the present invention by a ringlight providing an annular array of light-emitting elements centered about a viewing passage, wherein the improvement comprises: a first annular body, a second annular body mounted concentrically within the first annular body so as to form an annular void and light-emitting aperture therebetween, and a plurality of optical fibers extending into the void with end portions thereof secured therein so as to form an annular array of optical fiber end surfaces at said light-emitting aperture, the first and second bodies cooperating to angle the end portions of the plurality of optical fibers toward a central axis of the viewing passage.

4046 (UCRL-JC–111211) **Transient radiation effects in annealed proton exchange $LiNbO_3$ and $LiTaO_3$ waveguides.** Smith, D.E.; Hugenberg, K.F.; Flatley, J.E.; Garrett, H.E. Lawrence Livermore National Lab., CA (United States). 3 Sep 1992. 9p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. (CONF-9209184–5: The International Society for Optical Engineering (SPIE) meeting, Boston, MA (United States), 8-11 Sep 1992). Order Number DE93001621. Source: OSTI; NTIS; GPO Dep.

We have measured optical attenuation in $LiNbO_3$ and $LiTaO_3$ waveguides due to exposure to a ~3 ns pulse of ~400 KeV electrons. The $LiNbO_3$ operated at 810 nm and the $LiTaO_3$ at 1309 nm. Both waveguides were formed using the annealed proton exchange method. Transient attenuation and recovery was observed for a series of pulse doses. To the accuracy of the measurements, total recovery was observed within 1 sec after exposure for both waveguides. Results from these waveguides were compared to earlier measurements of a titanium-indiffused $LiNbO_3$ waveguide.

4047 (UM-P–92/45) **Neutron damage of silicon detectors at 20 deg C.** Bardos, R.; Gorfine, G.; Guy, L.; Moorhead, G.; Taylor, G.; Tovey, S. Melbourne Univ., Parkville (Australia). School of Physics. 27 Jun 1992. 20p. (SITP-NOTE–037.). Order Number DE93607941. Source: OSTI; NTIS (US Sales Only); INIS.

This contribution reports new data on the damage of silicon detectors by low energy (1 MeV) neutrons. The data were taken at the end of 1991. Three exposures of UA2 Inner Silicon detectors were made: at +20 deg C, -15 deg C and -95 deg C. A high neutron flux enabled the required fluences to be achieved in relatively short times. This increases the sensitivity of the experiment to damage types with shorter self-annealing time constants. This note discusses the new data taken at +20 deg C. Analysis of the low temperature exposures is in progress. 5 refs., 15 figs.

4048 (VTT-TIED–1203) **Total dose tests for the PROMICS-3 instrument.** Verkasalo, R. (Technical Research Centre of Finland, Espoo (Finland). Computer Technology Lab.). Technical Research Centre of Finland, Espoo (Finland). Jan 1991. 40p. Order Number DE93605912. Source: OSTI; NTIS; INIS.

The sensitivity of some analog and digital integrated circuits (IC's) to ionizing radiation was tested in order to evaluate their potential usefulness especially in the PROMICS-3 instrument. The PROMICS-3 is a plasma instrument to be flown on the Russian Interball satellites. The radiation tolerance requirement of the auroral Interball satellite is about 45 krad/year inside a shielding of 4 mm Aluminium. The IC's tested were: AD571 A/D- converter, AD-DAC80 D/A-converter, LF442A and PM108A operational amplifiers, MPREF0l voltage reference, STC SPXO 6 MHZ oscillator,4N55 optocoupler, MC5IC98 and CY7C164 16k*4 static CMOS RAM. Co-60 was used as the irradiation source. The test methods and results are described in the paper. The RAM-circuits failed between 10 and 20 krad. D/A- and A/D-converters degraded only slightly after 100 krad, but one of the A/D-converters failed functionally at 190 krad. The LF442A began to degrade in the test connection at 100 krad, and PM108A at 30 krad. The output voltage of the voltage reference MPREF01 increased about 20 mV after 100 krad. No change was observed in the output frequency of the STC SPXD oscillator even after 300 krad. The current tansfer ratio of the 4N55 decreased continuously to about 75 % of the initial value after 100 krad.

4404 Well Logging Instrumentation

Refer also to citation(s) 4296

4405 Thermal Instrumentation

Refer also to citation(s) 3924, 4696

4049 **Gold ink coating of thermocouple sheaths.** Ruhl, H.K. To Dept. of Energy. 4 Mar 1991. USAA patent application 7-663,51. 13p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC12-76SN00052. Order Number DE93002009. Source: OSTI; NTIS; GPO Dep.

A method is provided for applying a gold ink coating to a thermocouple sheath which includes the steps of electropolishing and oxidizing he surface of the thermoouple sheath into liquid gold ink, and finally heat curing the coating. The gold coating applied in this manner is highly reflective and does not degrade when used for an extended period of time in an environment having a temperature over 1000°F. Depending on the application, a portion of the gold coating covering the tip of the thermocouple sheath is removed by abrasion.

4406 Optical Instrumentation

Refer also to citation(s) 2798, 2911, 3561, 4004, 4460

4050 (DOE/ER/13949–4) **Molecular aspects of transport in thin films of controlled architecture: Technical summary, July 1, 1991–June 30, 1992.** Illinois Univ., Urbana, IL (United States). [1992]. 8p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG02-88ER13949. Order Number DE93003886. Source: OSTI; NTIS; GPO Dep.

Work was done in two principal areas: characterization of diffusion in swollen polymer films both with and without a barrier layer, and initial investigations of molecular aspects of swelling using enhanced Raman spectroscopy.

4051 **Optical transcutaneous bilirubin detector.** Kronberg, J.W. To Dept. of Energy. 4 Mar 1991. USAA patent application 7-663,51. 16p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC09-89SR18035. Order Number DE93002008. Source: OSTI; NTIS; GPO Dep.

This invention consists of a transcutaneous bilirubin detector comprising a source of light having spectral components absorbable and not absorbable by bilirubin, a handle assembly, electronic circuitry and a fiber optic bundle connecting the assembly to the light source and circuitry. Inside the assembly is a prism that receives the light from one end of the fiber optic bundle and directs it onto the skin and directs the reflected light back into the bundle. The other end of the bundle is trifucated, with one end going to the light source and the other two ends going to circuitry that determines how much light of each kind has been reflected. A relatively greater amount absorbed by the skin from the portion of the spectrum absorbable by bilirubin may indicate the presence of the illness. Preferably, two measurements are made, one on the kneecap and one on the forehead, and compared to determine the presence of bilirubin. To reduce the impact of light absorption by hemoglobin in the blood carried by the skin, pressure is applied with a plunger and spring in the handle assembly, the pressure limited by points of a button slidably carried in the assembly that are perceived by touch when the pressure applied is sufficient.

4052 **Precision surface machining.** Lazazzera, V.J.; Schmell, R.A. To Dept. of Energy. 6 Mar 1991. USAA patent application 7-665,06. 13p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. Order Number DE93002015. Source: OSTI; NTIS; GPO Dep.

Precision finishing apparatus utilizing line contact polishing to produce optical quality parts. A rotatable cylinder is horizontally disposed above a workpiece which is mounted on a rotatable, and

horizontally and vertically adjustable chuck. Predetermined surfaces can be cut into the surface of the cylinder to produce figures of revolution, such as aspheres,, when the workpiece is being rotated.

4053 (PNL–8352) **A comparison of surface topography characterization technologies for use in comparing spent bullet and cartridge case signatures.** Batishko, C.R.; Hickman, B.J.; Cuta, F.M. Pacific Northwest Lab., Richland, WA (United States). Nov 1992. 71p. Sponsored by Department of State, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE93002976. Source: OSTI; NTIS; GPO Dep.

The Pacific Northwest Laboratory was tasked by the US Department of Energy to provide technical assistance to the Federal Bureau of Investigation in evaluating and ranking technologies potentially useful in high-speed comparison of unique spent bullet and cartridge case surface signatures. Information sources included vendor input, current relevant literature, vendor phone contacts, other FBI resources, relevant PNL reports, and personal contact with numerous PNL technical staff. A comprehensive list of technologies was reduced to a list of 38 by grouping very similar methodologies, and further reduced to a short list of six by applying a set of five minimum functional requirements. A total of 14 primary criteria, many having secondary criteria, were subsequently used to evaluate each technology. The ranked short list results are reported and supported in this document, and their scores normalized to a hypothetical ideal system are as follows: (1) confocal microscopy 82.13; (2) laser dynamic focusing 72.04; (3)moire interferometry V70.94; (4)fringe field capacitance;(5)laser triangulation 66.18; (6)structured/sectioned light 65.55. Information available within the time/budget constraints which was used for the evaluation and ranking was not sufficiently detailed to evaluate specific implementations of the technologies. Each of the technologies in the short list was judged potentially capable of meeting the minimum requirements. Clever, novel engineering solutions resulting in a more cost-effective system, or a closer fit to the "ideal system," could result in a reordering of the short list when actual technical proposals are evaluated. Therefore, it is recommended that a Request for Proposal not be limited to only the highest ranked technology, but include all six technologies in the short list.

4407 Geophysical and Meteorological Instrumentation

4054 (GKSS–92/E/11) **Comparison of measurements of temperature and heat flux with a sonic-anemometer-thermometer and a fast platinum-wire-sensor.** Behrendt, M. (GKSS, Inst. fuer Physik, Geesthacht (Germany)). GKSS-Forschungszentrum Geesthacht GmbH, Geesthacht-Tesperhude (Germany); Fachhochschule Hamburg (Germany). Fachbereich Produktions- und Verfahrenstechnik. 1992. 115p. (In German). Order Number DE93728986. Source: OSTI; NTIS (US Sales Only).

In this study high resolution temperature data from the atmospheric surface layer has been analysed. These data were obtained by a Sonic-anemometer-thermometer and a fast platinum-wire-sensor. Turbulence measurements gathered during two field experiments have been analysed by means of statistical methods in order to characterize the time response of the temperature sensor. In case of the Sonic, power spectra, calculated using the Fast Fourier Transformation (FFT), did not show the theoretically expected spectral behaviour in the high frequency rance. The spectral curves were found to depend on the wind speed and direction, whereas spectra for the fast-temperature-sensor showed the expected spectral slopes. The comparison of 2nd order moments for the two sensors revealed an attenuation of the signal of the fast-temperature-sensor. (orig.) With 65 figs., 10 tabs.

4408 Miscellaneous Instrumentation

Refer also to citation(s) 2496, 2617, 2967, 3054, 3334, 3335, 3545, 3561, 3949, 4009, 4107, 4171, 4697

4055 **Self balancing measuring probe enclosure and method for waterproofing same.** Fodor, G.; Nilsen, R.J. To Dept. of Energy. 13 Feb 1991. USAA patent application 7-654,46. 13p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC11-76PN00014 ;AC11-89PN38014. Order Number DE93001999. Source: OSTI; NTIS; GPO Dep.

Waterproofing standard linear position measuring transducers often requires a sacrifice in measuring accuracy when the transducer must be used at varying water depths. To obviate this disadvantage, the disclosed waterproofing structure is constructed such that increasing or decreasing forces applied to the transducer as its depth in the water changes will not apply unbalanced forces to the transducer thereby causing false readings. Similarly, the nominal gauging force developed by the instrument is unaffected by varying water depths.

45 MILITARY TECHNOLOGY, WEAPONRY, AND NATIONAL DEFENSE

Refer also to citation(s) 2850, 3546, 3547, 4821, 4823

4056 (ANL/EAIS/TM–70-Vol.2) **Summary of requirements collected and prototype systems developed by Argonne National Laboratory in support of the SOFPARS program: Volume 2, Appendixes A–D.** Peerenboom, J.P.; Baines, T.B.; Braun, M.D.; Cortese, D.L.; Crowe, C.M.; Fuja, R.S.; Greene, R.J.; Gregor, R.A.; Kavicky, J.A.; Love, R.J.; Macal, C.M.; Nevins, M.R.; Paddock, R.A.; Ramsey, G.M.; Roberson, C.F.; Robinson, G.L.; St. Aubin, J.A.; Sapinski, PArgonne National Lab., IL (United States). Environmental Assessment and Information Sciences Div. May 1992. 428p. Sponsored by Department of Defense, Washington, DC (United States). DOE Contract W-31109-ENG-38. Order Number DE93000395. Source: OSTI; NTIS (US Sales Only); GPO Dep.

This document, Volume A, contains appendices A-D for the report on the Special Operations Forces Planning and Rehearsal Systems (SOFPARS). Appendix A contains information on logistics for the Army's and the Navy's prototype systems. Appendix B presents the lessons learned and the after action reports. Appendix C concerns scheduling the mission preparation process. And Appendix D is composed of information on targeting to include a targeting prototype, a demolitions prototype, and tool requirements.

4057 (ANL/EAIS/TM–70-Vol.3) **Summary of requirements collected and prototype systems developed by Argonne National Laboratory in support of the SOFPARS program: Volume 3, Appendixes E and F.** Peerenboom, J.P.; Baines, T.B.; Braun, M.D.; Cortese, D.L.; Crowe, C.M.; Fuja, R.S.; Greene, R.J.; Gregor, R.A.; Kavicky, J.A.; Love, R.J.; Macal, C.M.; Nevins, M.R.; Paddock, R.A.; Ramsey, G.M.; Roberson, C.F.; Robinson, G.L.; St. Aubin, J.A.; Sapinski, PArgonne National Lab., IL (United States). Environmental Assessment and Information Sciences Div. May 1992. 396p. Sponsored by Department of Defense, Washington, DC (United States). DOE Contract W-31109-ENG-38. Order Number DE93000394. Source: OSTI; NTIS (US Sales Only); GPO Dep.

This document, Volume III, contains appendices E-F of the report on the Special Operations Forces Planning and Rehearsal Systems program. Appendix E concerns mission analysis. A description of the prototype mission analysis module and observations and user feedback are included. Appendix F concerns intelligence. For this, command relationships, the role of intelligence in the targeting and mission planning process, sources of intelligence information, flow of intelligence, security considerations, joint targeting and mission planning, data accessibility, and data prioritization are included.

4058 (ANL/EAIS/TM–70-Vol.4) **Summary of requirements collected and prototype systems developed by Argonne National Laboratory in support of the SOFPARS program: Volume 4, Appendixes G–N.** Peerenboom, J.P.; Baines, T.B.; Braun, M.D.; Cortese, D.L.; Crowe, C.M.; Fuja, R.S.; Greene, R.J.; Gregor, R.A.; Kavicky, J.A.; Love, R.J.; Macal, C.M.; Nevins, M.R.; Paddock, R.A.; Ramsey, G.M.; Roberson, C.F.; Robinson, G.L.; St. Aubin, J.A.; Sapinski, PArgonne National Lab., IL (United States). Environmental Assessment and Information Sciences Div. May 1992. 386p. Sponsored by Department of Defense, Washington, DC (United States). DOE Contract W-31109-ENG-38. Order Number DE93000393. Source: OSTI; NTIS (US Sales Only); GPO Dep.

This document, Volume IV, contains appendices G-N of the Special Operations Forces Planning and Rehearsal Systems (SOFPARS) program. Appendix G contains briefback support. Appendix H concerns the application of artificial intelligence to SOFPARS. Appendix I discusses the application interface engine. Appendix J contains information management and data sources. Appendix K presents legal analysis as far as international law is concerned. Appendix L contains a SOFPARS survey form. Appendix M contains relevant acronyms. Appendix N is an annotated bibliography.

4059 (LA–12389-MS) **A continuum code investigation of stress integration using exact and approximate material rotation.** Davidson, R.F.; Maudlin, P.J. Los Alamos National Lab., NM (United States). Nov 1992. 28p. Sponsored by Department of Defense, Washington, DC (United States). DOE Contract W-7405-ENG-36. Order Number DE93001892. Source: OSTI; NTIS (US Sales Only); GPO Dep.

The accuracy of the Zaremba-Jaumann-Noll stress rate (referred to here as the Jaumann Stress Rate) used in various continuum mechanics codes is investigated using two realistic warhead formation problems that involve isotropic plasticity, large deformations, and large rigid body rotation. It has been demonstrated in the literature for simple problems that, although the Jaumann Stress Rate is objective (i.e., under superimposed rigid body rotation, it transforms in like manner as the stress or strain rate), it is not kinematically consistent because it uses the anti-symmetric part of the velocity gradient tensor to approximate rigid body rotation. A theoretically correct approach would use an objective stress rate that is kinematically consistent via the use of the exact rigid body rotation rate. It is shown in this work that, although the Jaumann Stress Rate is sufficiently accurate for gross deformation, inspection of the stress-strain details show kinetical errors. The computational expense of using an exact rotation rate is shown to be insignificant.

4060 (SAND–88-2958-Rev.) **Standard Annunciator software overview.** Anspach, D.A. (Sandia National Labs., Albuquerque, NM (United States)); Fox, E.T.; Kissock, P.S. Sandia National Labs., Albuquerque, NM (United States). Oct 1992. 186p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-76DP00789. Order Number DE93004025. Source: OSTI; NTIS; GPO Dep.

The Standard Annunciator Software is responsible for controlling the AN/GSS-41 and AN/GSS-44 Annunciator Systems. The software interfaces with other systems-ACS, ECS, CCTV, UPS-to determine current alarm, tamper, and hardware status. Current system status conditions are displayed at the operator's console and on display maps. This manual describes the organization and functionality of the software as well as the generation mechanisms for development and target environments.

4061 (SAND–92-0667C) **System development of a 120 mm tandem-rod kinetic energy projectile.** Luk, V.K.; Hickerson, J.; Hodapp, A.E.; Foster, A.D. Sandia National Labs., Albuquerque, NM (United States). 1 Oct 1992. 15p. Sponsored by Department of Defense, Washington, DC (United States). DOE Contract AC04-76DP00789. (CONF-9210205–1: 2. ballistics symposium on classified topics, Baltimore, MD (United States), 26-29 Oct 1992). Order Number DE93002307. Source: OSTI; NTIS (US Sales Only); GPO Dep.

Preliminary system design and testing has been done for a prototype tank-fired projectile consisting of two tethered kinetic energy penetrators flying in tandem. The projectile has principal application against reactive armor, but also exhibits potential against ceramic armors and conventional armor. The projectile is designed to be launched by the current M829 cartridge and propellant from a standard 120 mm smooth-bore cannon. This paper discusses the design principals, configuration, terminal ballistics of scale model penetrators, and the results of preliminary gun tests conducted at full scale. Similar concepts are discussed and compared with the Sandia design.

4501 Chemical Explosions and Explosives

Refer also to citation(s) 4078

4062 (CONF-890398–, pp. 69-74) **Near-source observations of quarry explosions.** Johnson, L.R. (Lawrence Berkeley Lab., CA (United States)). Lawrence Livermore National Lab., CA (United States). 12 May 1989. From DOE/LLNL symposium on explosion-source phenomenology; Lake Tahoe, CA (United States); 14-16 Mar 1989. In *Proceedings of the DOE/LLNL symposium on Explosion-Source Phenomenology.* 251p. Order Number DE89016501. Source: OSTI; NTIS.

Seismic waveform data have been recorded from a series of chemical explosions in the Kaiser Permanente Quarry near Menlo Park, California. The explosions were arranged by Dr. Willie Lee of the US Geological Survey. The University of California's part of the experiment was to record broadband waveform data at a network of stations surrounding the sources. The recording experiment at the quarry was very similar to experiments performed in the past for nuclear explosions at the Nevada Test Site, with all distances and depths scaled down by a factor of about 10 for the quarry experiment. Ten different explosive events were recorded, including single explosions at various depths in drilled holes, regular quarry blasts consisting of simultaneous explosions in clusters of shallow drilled holes, and one event consisting of the combination of a quarry blast and a single explosion in a drilled hole with both fired at about the same time. Analysis of the data collected in this experiment has just begun, and the initial analysis has concentrated on examining the effects of source depth upon the waveforms. As information about the velocity structure in the quarry is developed, it should also be possible to perform moment tensor inversions and thus obtain direct estimates of the source functions.

4063 (LA-UR–92-2915) **Understanding curved detonation waves.** Bukiet, B.G. (New Jersey Inst. of Tech., Newark, NJ (United States). Dept. of Mathematics); Menikoff, R. Los Alamos National Lab., NM (United States). [1992]. 4p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. (CONF-9207159–1: 10. detonation symposium, Boston, MA (United States), Jul 1992). Order Number DE93000799. Source: OSTI; NTIS; GPO Dep.

A wave curve is the set of final states to which an initial state may be connected by a traveling wave. In gas dynamics, for example, the wave curve consists of the shock Hugoniot curve for compressive waves and the rarefaction curve for expansive waves. In this paper, we discuss the wave curve for an undriven planar detonation and for general planar detonations. We then extend the wave curve concept to detonations in converging and diverging geometry. We also discuss the application of these wave curves to the numerical computation of detonation problems.

4064 (MLM–3764(OP)) **Development of hermetic, optical fiber, laser initiated, pyrotechnic devices.** Kramer, D.P.; Ewick, D.W.; Beckman, T.M. EG and G Mound Applied Technologies, Miamisburg, OH (United States). [1991]. 10p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-88DP43495. (CONF-910430–33: 93. annual meeting and exposition of the American Ceramic Society (ACerS), Cincinnati, OH (United States), 28 Apr - 2 may 1991). Order Number DE93001969. Source: OSTI; NTIS (US Sales Only); GPO Dep.

It has been demonstrated that the fabrication of hermetic, optical fiber, laser initiated, pyrotechnic devices is possible. This new technology based on a laser/optical fiber combination in place of bridgewire(s) and pin(s) can readily be adapted to various engineering requirements. Several novel processing technique have been developed for fabricating the devices that exhibit the required strength and hermeticity to ensure the successful functioning of the device. Examples of several types of laser initiated devices have been fabricated and tested using a variety of pyrotechnic materials. These function tests have confirmed that reliable, high strength devices can be produced. The results illustrate that there are no fundamental reasons that laser ignited components should not be considered for future designs of pyrotechnic devices.

4065 (MLM–3765(OP)) **Application of isothermal calorimetry and uv spectroscopy for stability monitoring of pentaerythritol tetranitrate.** Dosser, L.R.; Pickard, J.M. EG and G Mound Applied Technologies, Miamisburg, OH (United States). [1992]. 7p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-88DP43495. (CONF-9209162–2: 21.

North American Thermal Analysis Society meeting, Atlanta, GA (United States), 13-16 Sep 1992). Order Number DE93001970. Source: OSTI; NTIS; INIS; GPO Dep.

Thermal stabilities for a series of pentaerythritol-tetranitrate (PETN) samples with variable surf ace areas were monitored by isothermal calorimetry and UV spectroscopy over the temperature range of 363 to 408 K. Isothermal induction times measured with constant volume calorimetry under an air atmosphere and No evolution rates monitored by UV absorbance at 213 nm under vacuum correlated with the PETN surface area at temperatures equal to or exceeding 383 K. Rate data measured at 383 K are in accord with predictions based on detailed kinetic modeling. Below 383 K, NO evolution data suggested that additional geometric factors may be significant in controlling PETN stability. Mechanisms for influencing surface area upon the rate-determining step are addressed.

4066 **Hydrogen loaded metal for bridge-foils for enhanced electric gun/slapper detonator operation.** Osher, J.E. To Dept. of Energy. 20 Mar 1991. USAA patent application 7-672,27. 20p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. Order Number DE93002032. Source: OSTI; NTIS (US Sales Only); GPO Dep.

The invention provides a more efficient electric gun or slapper detonator which provides a higher velocity flyer by using a bridge foil made of a hydrogen loaded metal.

4502 Nuclear Explosions and Explosives

Refer also to citation(s) 4079, 4080, 4081, 4082, 4083, 4084, 4085, 4086, 4087, 4088, 4089, 4091, 4092, 4094, 4095, 4096, 4097, 4099, 4100, 4122

4067 (CONF-890398–, pp. 29-36) **Free field stress, acceleration, velocity, and displacement data available from contained detonations at the Nevada Test Site.** Bass, R.C. (Sandia National Labs., Albuquerque, NM (United States)). Lawrence Livermore National Lab., CA (United States). 12 May 1989. From DOE/LLNL symposium on explosion-source phenomenology; Lake Tahoe, CA (United States); 14-16 Mar 1989. In *Proceedings of the DOE/LLNL symposium on Explosion-Source Phenomenology.* 251p. Order Number DE89016501. Source: OSTI; NTIS.

Sandia National Laboratories has been involved in earth motion measurement programs at the Nevada Test Site since activity began there in 1951. Early programs consisted of earth motion measurements made below air bursts that then comprised the majority of the test detonations. Measurements were also made on the surface and later underground tests through the 1950s and several high explosive tests. Large scalo programs included the RAINIER experiment and the later PNE related SCOOTER and BUCKBOARD conventional high explosive detonations. Data obtained during the air blast era and through the early portion of the underground test program are essentially limited to measurements of acceleration and velocity and to displacement values deduced from single and double integrations as appropriate. Measurement techniques developed since 1970 permit the gathering of stress wave shape data at over a range of a few tenths of a kilobar up to tens of kilobars. These measurements have primarily been attempted on Defense Nuclear Agency effects tests that have utilized tunnel emplacements in Rainier Mesa. This test configuration allows accurate, controlled gauge emplacement techniques that have also permitted more accurate acceleration, velocity, and displacement measurements. Measurement of pressure and acceleration has continued on LANL and LLNL vertically emplaced detonations though these test configurations are less desirable from gauge emplacement and positioning considerations.

4068 (CONF-890398–, pp. 75-91) **Effects of in-situ stress and fracture spacing on ground motion and spall from underground nuclear explosions.** Rawson, G. Lawrence Livermore National Lab., CA (United States). 12 May 1989. From DOE/LLNL symposium on explosion-source phenomenology; Lake Tahoe, CA (United States); 14-16 Mar 1989. In *Proceedings of the DOE/LLNL symposium on Explosion-Source Phenomenology.* 251p. Order Number DE89016501. Source: OSTI; NTIS.

A large number of measurements on French and US underground nuclear tests are reviewed and analyzed. In understanding how geology influences the effects from tests, the French tests are particularly important. This is because the setting for the tests had larger fracture spacing and higher effective confining (in-situ) stresses than any US test. The importance of the French data review is especially important because a misunderstanding about the ground motion data is clarified. The measurements are almost certainly free-surface, not free-field, as has been repeatedly assumed. The author believes this analysis will serve to help restructure analytical modeling of certain earth responses to well coupled nuclear explosions. In particular he estimates that high in-situ stress environments enable tests to be conducted at much more shallow depths than the US experience without cratering or gross disruption of the ground surface. Explosion induced surface spall is expected to be significantly restricted by reduced jointing and fracturing of the rock coupled with increased in-situ stresses (when compared to US experience). Changes in surface waves and spall signals can also be expected. Spall signal character may indicate tests being conducted near the critical depth for 'containment.' A threshold is anticipated where increased in-situ stress limits spall until some strength criterion is exceeded. Then spall could contribute greatly to surface rupturing and even cratering.

4069 (CONF-890398–, pp. 102-104) **Far-field workshop.** Helmberger, D. Lawrence Livermore National Lab., CA (United States). 12 May 1989. From DOE/LLNL symposium on explosion-source phenomenology; Lake Tahoe, CA (United States); 14-16 Mar 1989. In *Proceedings of the DOE/LLNL symposium on Explosion-Source Phenomenology.* 251p. Order Number DE89016501. Source: OSTI; NTIS.

The major issues addressed in the far-field workshop include many of the same topics discussed in the other workshops; namely, source excitation of phases, contamination of spall and tectonic release and how these are effected by depth of burial and material properties. The key to transportability of yield estimators lies in documentation of the latter effects. It was generally agreed that major improvements in yield estimation at smaller yields appears possible if adequate corrections for these source environmental effects and propagational distortions can be made. The discussion centered around the specific problems encountered with conventional yield methods based on short-period (m_b), long period Rayleigh waves (M_s and M_o) and Lg and the impact of broad-band (BB) data.

4070 (CONF-890398–, pp. 105-113) **The teleseismic manifestation of pP: Problems and paradoxes.** Lay, T. (Univ. of Michigan, Ann Arbor (United States)). Lawrence Livermore National Lab., CA (United States). 12 May 1989. From DOE/LLNL symposium on explosion-source phenomenology; Lake Tahoe, CA (United States); 14-16 Mar 1989. In *Proceedings of the DOE/LLNL symposium on Explosion-Source Phenomenology.* 251p. Order Number DE89016501. Source: OSTI; NTIS.

The nature of the free surface interaction for upgoing compressional waves from underground explosions has been the focus of active research for twenty years; however, there is still no consensus on this fundamental influence on the teleseismic radiation. Many techniques have been developed in attempts to quantify the pP arrival and any additional source complexity, yet all suffer from the limited bandwidth available in teleseismic P waves and the strong trade-offs between source, attenuation and receiver effects. The existence of complex spalling processes, readily observed in the near-field, which must be physically linked to the pP energy suggest the likelihood that pP will have a complex teleseismic manifestation. However, there is also compelling evidence that for periods longer than about 2 sec, pP should be a strong coherent phase. This is based on the differentiated appearance of P arrivals on WWSSN long period instruments for large events. The question at hand, then, is how much is known about the high frequency characteristics of the pP arrival? At present, the most stable procedure for addressing the teleseismic manifestation of pP appears to be simple broadband ground motion restitution. Methods which attempt to eliminate receiver effects explicitly either require too many assumptions about the source (as for intercorrelation) or involve instability in the spectral factoring of source and receiver terms for

narrow band data from overly similar suites of events (as for multi-station deconvolution). Analysis of a global distribution of broadband ground motions, for which event averaged characteristics could be determined, offers some promise for improving our understanding of the free surface interaction; however, there remains a tradeoff with source and attenuation models which is intrinsic to the problem.

4071 (CONF-890398–, pp. 157-158) **The effects of spall on teleseismic P-waves: An investigation with theoretical seismograms.** Schlittenhardt, J. (Federal Inst. for Geosciences and Natural Resources, Hannover (Germany)). Lawrence Livermore National Lab., CA (United States). 12 May 1989. From DOE/LLNL symposium on explosion-source phenomenology; Lake Tahoe, CA (United States); 14-16 Mar 1989. In *Proceedings of the DOE/LLNL symposium on Explosion-Source Phenomenology*. 251p. Order Number DE89016501. Source: OSTI; NTIS.

The HARZER event was monitored by seismic instruments at both local and regional distances and there is evidence that this event produced seismic radiation related to the spallation of surface layers. The effect of spall on teleseismic P-waves is investigated using theoretical seismograms calculated with an extended reflectivity method. The source excitation function for the spall consists of a system of three vertical single forces representing the detachment, relaxation and slapdown phase of the spall process. This equivalent point source model is momentum conserving, and can be parameterized by two quantities, the momentum I_s and the ballistic period T_s of the spalled mass.

4072 (CONF-890398–, pp. 159-165) **Body wave observations of tectonic release.** Wallace, T.C. (Univ. of Arizona, Tucson (United States)). Lawrence Livermore National Lab., CA (United States). 12 May 1989. From DOE/LLNL symposium on explosion-source phenomenology; Lake Tahoe, CA (United States); 14-16 Mar 1989. In *Proceedings of the DOE/LLNL symposium on Explosion-Source Phenomenology*. 251p. Order Number DE89016501. Source: OSTI; NTIS.

Precise and accurate yield determination from seismic waveforms requires detailed knowledge of all the processes which are contributing to the waveform. Besides the explosion source, other important processes include spall, 'non-elastic' pP, scattering, and tectonic release. Tectonic release is observed as nonisotropic seismic radiation; the presence of SH and Love waves is a fairly common observation on the seismic records of many underground nuclear explosions. Tectonic release is thought to be 'a release of preexisting strains in the material around the explosion.' There are two basic models for this strain release: (1) triggered movement on nearby faults, and (2) stress relaxation from the highly fractured zone immediately around the detonation point. For either of the stress release models, the long-period teleseismic radiation pattern can be represented by an equivalent double-couple source. In principal, the seismic radiation field from the tectonic release could bias a yield estimate which was based on a seismic amplitude measurement. Depending on the orientation of the double couple representing the tectonic release, seismic signals from an explosion could be enhanced or diminished. In this paper, the author reviews the evidence for a high-frequency signature of tectonic release, and outlines outstanding problems.

4073 (CONF-890398–, pp. 184-185) **Anomalies in the results of the SALMON experiment.** Glenn, L.A. (Lawrence Livermore National Lab., CA (United States)). Lawrence Livermore National Lab., CA (United States). 12 May 1989. DOE Contract W-7405-ENG-48. From DOE/LLNL symposium on explosion-source phenomenology; Lake Tahoe, CA (United States); 14-16 Mar 1989. In *Proceedings of the DOE/LLNL symposium on Explosion-Source Phenomenology*. 251p. Order Number DE89016501. Source: OSTI; NTIS.

SALMON was a 5.3 kt tamped nuclear explosion at a depth of 830 m that took place on October 22, 1964 in the Tatum salt dome near Hattiesburg, Mississippi. Free-field particle velocity was measured at horizontal distances ranging from 225 to 742 m from the work point. The data indicate that the salt behaved inelastically out to the farthest gauge location. Moreover, a 2-wave structure was observed, with propagation velocities of 4.55 km/s and 3.80 km/s. The former value agrees well with the predetermined p-wave speed in the Tatum salt. The latter value is 300 m/s higher than the predetermined bulk wave speed, which would be the propagation velocity of the plastic wave if the salt were an elastic-perfectly plastic medium. Laboratory measurements showed that the yield strength is independent of pressure, with values ranging from 35 MPa for annealed salt to over 80 MPa for polycrystalline salt. Computational attempts to simulate the experimental results with these data were unsuccessful. An explanation for the anomalous behavior appears to be that the strength of the in situ salt is extremely sensitive to strain hardening. The plastic wave speed is enhanced, in this case, by an increment that is proportional to the gradient of the yield strength with respect to strain. Calculations made with a constitutive model in which the salt first hardens with plastic work, and then loses virtually all strength as the plastic work exceeds a fixed limit, give good qualitative agreement with most observations. Nevertheless, it must be noted that the values of the model parameters required to give even modest agreement are inconsistent with independently measured material properties.

4074 (CONF-890398–, pp. 186-204) **Estimates of seismic coupling and nuclear explosion yields using seismic magnitude and moment data.** Archambeau, C.B. Lawrence Livermore National Lab., CA (United States). 12 May 1989. From DOE/LLNL symposium on explosion-source phenomenology; Lake Tahoe, CA (United States); 14-16 Mar 1989. In *Proceedings of the DOE/LLNL symposium on Explosion-Source Phenomenology*. 251p. Order Number DE89016501. Source: OSTI; NTIS.

Observations of the spectral character of direct compressional waves from underground nuclear explosions, both in the near and far field distance ranges, suggest that the purely explosive produced P wave has a form that can be represented by a simple step function pressure equivalent. Using this simple equivalent source representation and the assumption that the (reversible) work done on the medium outside the elastic radius is proportional to yield, it follows that m_b values depend directly on yield and upon two source dependent coupling parameters K_c and K_E, which are termed the non-linear and elastic coupling parameters, respectively. It is found that the available magnitude-yield data for US nuclear explosions, in a wide variety of media, require four sets of the coupling constants, K_c and K_E, for a simultaneous description of both m_b and the M_s observations. The resulting empirical magnitude-yield curves correspond to a high coupling set for m_b and M_s, two intermediate coupling sets and a low coupling set. These magnitude-yield curve sets provide a means of estimating yield using both m_b and M_s together, provided tectonic release effects and differences in test site absorption, relative to NTS, are taken into account. On the other hand, if the range of coupling at some other test site is assumed to be within the range sampled by the US data, then it is possible to estimate the (combined) difference in near site absorption and tectonic effects between NTS and any other test site.

4075 (CONF-890398–, pp. 241-242) **Discrete element modeling of explosions in jointed rocks.** Walton, O.R. (Lawrence Livermore National Lab., CA (United States)); Heuze, F.E. Lawrence Livermore National Lab., CA (United States). 12 May 1989. From DOE/LLNL symposium on explosion-source phenomenology; Lake Tahoe, CA (United States); 14-16 Mar 1989. In *Proceedings of the DOE/LLNL symposium on Explosion-Source Phenomenology*. 251p. Order Number DE89016501. Source: OSTI; NTIS.

The character of seismic waves emanating from contained underground explosions in fractured rock may be strongly affected by the discrete nature of the jointed rock surrounding the explosion. Traditionally, the analysis of explosive events has been performed by using dynamic continuum codes, mostly based on finite difference approximations. These techniques are not adequate for calculating full cratering processes for less deeply buried explosives primarily because they cannot handle large displacement discontinuities, fragmentation and subsequent ballistic motion of rock fragments. Discrete element models, on contrast, have only recently been applied to dynamic simulation of explosive effects and are relatively immature as a modeling technique. Such models follow the motion of each individual rock block, and produce shear dilatant forces as a natural consequence of block displacements

and rotations. Thus, these models are well suited for simulation of cratering in hard rock and work is currently underway to enhance the capabilities of current two and three dimensional models for dynamic simulation of explosive events. Discrete element simulations of cratering events in fractured rock with existing models indicate that strong shear dilatant forces act in the early stages of lifting the overburden. More deeply buried events may also exhibit temporary shear displacements in localized regions of the overburden of sufficient magnitude to produce significant shear dilatant forces. Such behavior could exhibit itself as a distributed 'secondary' source, separated in space and time from the primary compressive wave emanating directly from the explosive cavity region.

4076 (LA–12434-MS) **Static-stress analysis of dual-axis confinement vessel.** Bultman, D.H. Los Alamos National Lab., NM (United States). Nov 1992. 21p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. Order Number DE93000499. Source: OSTI; NTIS; GPO Dep.

This study evaluates the static-pressure containment capability of a 6-ft-diameter, spherical vessel, made of HSLA-100 steel, to be used for high-explosive (HE) containment. The confinement vessel is designed for use with the Dual-Axis Radiographic Hydrotest Facility (DARHT) being developed at Los Alamos National Laboratory. Two sets of openings in the vessel are covered with x-ray transparent covers to allow radiographic imaging of an explosion as it occurs inside the vessel. The confinement vessel is analyzed as a pressure vessel based on the ASME Boiler and Pressure Vessel Code, Section VIII, Division 1, and the Welding Research Council Bulletin, WRC-107. Combined stresses resulting from internal pressure and external loads on nozzles are calculated and compared with the allowable stresses for HSLA-100 steel. Results confirm that the shell and nozzles of the confinement vessel are adequately designed to safely contain the maximum residual pressure of 1675 psi that would result from an HE charge of 24.2 kg detonated in a vacuum. Shell stresses at the shell-to-nozzle interface, produced from external loads on the nozzles, were less than 400 psi. The maximum combined stress resulting from the internal pressure plus external loads was 16,070 psi, which is less than half the allowable stress of 42,375 psi for HSLA-100 steel.

4077 (SAND–92-0452) **SE3158 development report.** Siddiqui, M.A. Sandia National Labs., Albuquerque, NM (United States). Sep 1992. 13p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-76DP00789. Order Number DE93004026. Source: OSTI; NTIS; GPO Dep.

This report describes the SE3158 design and development tester that was designed by Digital Subsystem III Division 2314 at Sandia to support the development of the MC4073 SRAM II Programmer. The primary purpose of the SE3158 is to test the MC4073 SRAM II Programmer during its development phase.

4078 (SAND–92-0837) **Evaluation of factors affecting the timing capabilities of the MC3858 sprytron.** Lee, S.R.; Barclay, C.J. Sandia National Labs., Albuquerque, NM (United States). Apr 1992. 39p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-76DP00789. Order Number DE93003234. Source: OSTI; NTIS (US Sales Only); GPO Dep.

The switch delay time of the MC3858 sprytron was measured using a test matrix consisting of 36 different trigger circuit configurations. The test matrix allowed the measurement of switch delay times for peak trigger voltages ranging from 47 V to 1340 V and for stored trigger energies ranging from 0.023 mJ to 2.7 mJ. The average switch delay time was independent of peak trigger voltage above approximately 800 V. Similarly, the average switch delay was independent of trigger stored energy above approximately 0.5 mJ. Below these saturation values, the average switch delay increases rapidly with decreasing trigger voltage or esergy. In contrast to the average switch delay time, the shot-to-shot variability in switch delay time does not appear to be strongly affected by peak trigger voltage as long as the trigger voltage is groater than 100 V. Below 100 V, the variability in switch delay time rises rapidly due to failure of the trigger to undergo immediate high voltage breakdown when trigger voltage is applied. The effect of an abnormally-high-resistance trigger probe on switch delay time was also investigated. It was found that a high-resistance probe behaved as a second overvoltage gap in the trigger circuit. Operation with a peak trigger voltage greater than the breakdown voltage of this second gap yielded delay times comparable to operation with a normal trigger. Operation with a peak trigger voltage less than the breakdown voltage of this second gap increased the switch delay time by an amount comparable to the time required to ramp the trigger circuit output up to the breakdown voltage of the second gap. Finally, the effect that varying the bias voltage applied to the sprytron has on switch delay time was measured. The switch delay time did not appear to depend on bias voltage for bias voltages between 725 V and 2420 V.

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4079 (CONF-890398–, pp. 1-5) **Near-field workshop.** Murphy, J.R. (S-Cubed, Reston, VA (United States)); Stump, B.W. Lawrence Livermore National Lab., CA (United States). 12 May 1989. From DOE/LLNL symposium on explosion-source phenomenology; Lake Tahoe, CA (United States); 14-16 Mar 1989. In *Proceedings of the DOE/LLNL symposium on Explosion-Source Phenomenology.* 251p. Order Number DE89016501. Source: OSTI; NTIS.

The objectives of the near-field working group meeting were to draw up specific recommendations for the archiving of existing data and the design of data collection experiments which could be directed toward the improved definition of the seismic source function corresponding to underground nuclear explosions. Preliminary discussions were wide-ranging and served to generate a rough consensus concerning both the current status of the empirical data base and a general recommended course of action for addressing some of the more important outstanding problem areas. With regard to the existing near-field data base, it was agreed that a coordinated effort between the various DOE laboratories is required in order to insure that the historical data are reduced and cataloged in a uniform manner and made readily available to those conducting research on the explosion seismic source function.

4080 (CONF-890398–, pp. 13-28) **Spatial variations in free-field and free surface ground motions from explosions and the constraint of physical source mechanisms.** Stump, B.W. (Southern Methodist Univ., Dallas, TX (United States)); Reinke, R.E. Lawrence Livermore National Lab., CA (United States). 12 May 1989. From DOE/LLNL symposium on explosion-source phenomenology; Lake Tahoe, CA (United States); 14-16 Mar 1989. In *Proceedings of the DOE/LLNL symposium on Explosion-Source Phenomenology.* 251p. Order Number DE89016501. Source: OSTI; NTIS.

A physically based understanding of the explosive source function is necessary for improving discrimination between earthquakes and explosions as well as refining yield estimates for explosions. The physical understanding of source processes allows prediction and extrapolation to new environments where experimental evidence may not exist. A purely experimental approach to the problems of discrimination and yield determination may be adequate for limited conditions but can not be acceptable for the wide range of conditions that exist in the earth. For this reason the authors report on recent studies designed to constrain the physical mechanisms accompanying the generation of seismic waves from explosive sources.

4081 (CONF-890398–, pp. 37-43) **Amplitude-dependent attenuation and implications for the seismic source.** Bonner, B. (Lawrence Livermore National Lab., CA (United States)); Wanamaker, B.J.; Taylor, S.R. Lawrence Livermore National Lab., CA (United States). 12 May 1989. From DOE/LLNL symposium on explosion-source phenomenology; Lake Tahoe, CA (United States); 14-16 Mar 1989. In *Proceedings of the DOE/LLNL symposium on Explosion-Source Phenomenology.* 251p. Order Number DE89016501. Source: OSTI; NTIS.

As an outgoing stress pulse travels away from an explosive source, it encounters regions in which the material properties apparently change with range. Amplitude decays more rapidly near the source, until finally at some distance the stress pulse attenuates at a constant rate appropriate for arbitrarily small strains. Field

observations and laboratory experience suggest that there is a near-source region of amplitude-dependent attenuation, beyond the range where macroscopic damage to the host medium occurs. For example, source corner frequencies computed from finite-difference simulations of medium response are systematically higher than those inferred from teleseismic observations (Rimer and Cherry, 1982, and Archambeau, 1985). Spectral discriminants for low-yield events at the Nevada Test Site (NTS) show that explosions are deficient in high frequencies relative to earthquakes. Small explosions show excessive roll-off of power e.g., spectra between 2 and 8 Hz, e.g., greater than expected for second-order models with reasonable Q corrections (Taylor et al., 1988). Attenuation of wavefields in dome salt requires strong attenuation (Q^{-1} = 0.05) in the near-source region (Trulio, 1985). Attempts to model source effects in dome salt require dramatic nonlinear attenuation effects to match observations over the strain range to 10^{-6} (Minster and Day, 1986). Although there are alternative explanations for these observations, often requiring that the source rise time be finite, amplitude-dependent attenuation is observed without ambiguity in laboratory experiments (Gordon and Rader, 1971).

4082 (CONF-890398–, pp. 52-68) **Modeling near-field data at NTS and Amchitka.** Helmberger, D.; Burdick, L.; Stead, R. Lawrence Livermore National Lab., CA (United States). 12 May 1989. From DOE/LLNL symposium on explosion-source phenomenology; Lake Tahoe, CA (United States); 14-16 Mar 1989. In *Proceedings of the DOE/LLNL symposium on Explosion-Source Phenomenology*. 251p. Order Number DE89016501. Source: OSTI; NTIS.

Modeling teleseismic body waveforms from earthquakes has progressed considerably in recent years while corresponding progress in modeling explosions has not. There are still disagreements on the nature of the explosion source with several representations of RDPs available, w^{-2} and w^{-3}, and with differences in corner frequency. It appears that teleseismic data alone can not resolve this issue because of complications caused by the Earth's attenuation, and complex $_pP$ interaction with spall. Thus, modeling the near-in data may help answer some questions and focus attention on some key issues. In this brief review the authors examine some of the difficulties encountered in near-in modeling in terms of crustal complexities and styles of interpreting the data in terms of source characterization.

4083 (CONF-890398–, pp. 92-99) **Stochastic geologic effects on near-field ground motions.** Reinke, R.E. (Air Force Weapons Lab., Kirtland AFB, NM (United States)); Anderson, K.R.; Goerke, R.V.; Leverette, J.A.; Stump, B.W. Lawrence Livermore National Lab., CA (United States). 12 May 1989. From DOE/LLNL symposium on explosion-source phenomenology; Lake Tahoe, CA (United States); 14-16 Mar 1989. In *Proceedings of the DOE/LLNL symposium on Explosion-Source Phenomenology*. 251p. Order Number DE89016501. Source: OSTI; NTIS.

Over the course of the past few years the Air Force Weapons Laboratory has conducted a series of small scale high explosive field experiments in an effort to better understand the seismic source function. One of the lessons learned from these experiments is that random geologic variations have a significant influence on the results of these experiments and that any attempt to model these experiments must take into account these stochastic effects. Several of the tests, ranging in size from 5 to 100 pounds, were designed specifically to study the effects of random geologic inhomogeneity upon small scale spatial variability in ground motion. This paper discusses the results of these tests and the implications of random geologic variability for the interpretation of near-field ground motions.

4084 (CONF-890398–, pp. 100-101) **Free-field particle velocity and yield.** Wheeler, V. (Lawrence Livermore National Lab., CA (United States)); Hudson, B. Lawrence Livermore National Lab., CA (United States). 12 May 1989. From DOE/LLNL symposium on explosion-source phenomenology; Lake Tahoe, CA (United States); 14-16 Mar 1989. In *Proceedings of the DOE/LLNL symposium on Explosion-Source Phenomenology*. 251p. Order Number DE89016501. Source: OSTI; NTIS.

Lawrence Livermore National Laboratory routinely fields instrumentation on underground nuclear tests, usually to determine whether various stemming features are properly emplaced and how well they perform when challenged, and to answer basic phenomenological questions. The Containment Program is also responsible for fielding appropriate instrumentation related to the Threshold Test Ban Treaty (TTBT) and more general treaty verification activities. The authors routinely measure motion in the upper half of the emplacement hole, at the surface near ground zero, and in the recording trailer park. They have occasionally measured ground motion in satellite instrumentation holes and on the surface at distances somewhat beyond the depth of burial. The primary purpose of these measurements has been to determine the effects of ground motion on event-related features such as stemming plugs within the emplacement hole, recording trailers, and near by drill holes planned for other events. Consequently, the instrumentation is often not optimally located for the purpose of gathering specific free-field ground motion data. Data from many of these measurements are, however, representative of the 'free-field' ground motions.

4085 (CONF-890398–, pp. 114-127) **Regional seismic observations from NTS explosions.** Taylor, S.R. (Lawrence Livermore National Lab., CA (United States)). Lawrence Livermore National Lab., CA (United States). 12 May 1989. From DOE/LLNL symposium on explosion-source phenomenology; Lake Tahoe, CA (United States); 14-16 Mar 1989. In *Proceedings of the DOE/LLNL symposium on Explosion-Source Phenomenology*. 251p. Order Number DE89016501. Source: OSTI; NTIS.

The interest in monitoring a Comprehensive Test Ban Treaty or a Low Yield Threshold Test Ban Treaty using in-country networks has produced a vast amount of literature on the generation and propagation of regional seismic phases. Regional phases have proven to be essential for improving detection, identification, and yield estimation capabilities at small magnitudes where teleseismic signals are hampered by poor signal to noise ratios. However, regional signals are typically very complex and it is unclear how much source information is contained in them or whether they are totally dominated by propagation effects. For example, Gupta and Blandford (1983) have demonstrated the importance of scattering by heterogeneities on the nature of regional signals. Even regional synthetic seismograms calculated in a simple layered earth structure demonstrate the complex nature of regional signals. In this paper, the author discusses the utilization of regional phases to study the explosion source. This work was initiated as an outgrowth of a regional discrimination study of western US earthquakes and NTS explosions. In an attempt to identify why certain explosions were classified as earthquakes for certain discriminants, the author has learned how near-source processes may affect the radiated seismic signals. He begins with a description of some of the discriminants and identification of explosion outliers. Using information regarding emplacement geometry, simple numerical models, and available close-in accelerometer data, he has been able to identify a number of near-source processes that can complicate the generation of regional phases. It is concluded that a number of near-source processes mostly acting above the explosion source region can explain the anomalous data points identified in this study.

4086 (CONF-890398–, pp. 128-134) **Seismic moment estimation of underground nuclear explosions: A review of surface wave results and implications for the source.** Patton, H.J. (Lawrence livermore National Lab., CA (United States)). Lawrence Livermore National Lab., CA (United States). 12 May 1989. DOE Contract W-7405-ENG-48. From DOE/LLNL symposium on explosion-source phenomenology; Lake Tahoe, CA (United States); 14-16 Mar 1989. In *Proceedings of the DOE/LLNL symposium on Explosion-Source Phenomenology*. 251p. Order Number DE89016501. Source: OSTI; NTIS.

One of the outstanding unsolved problems in the understanding of the explosion source is the long-period scaling of the source spectrum. This is graphically illustrated in Murphy's paper on seismic source functions and magnitude determinations, where various near-regional, regional, and teleseismic data for Nevada Test Site (NTS) explosions are compared to the modified Mueller and Murphy source model. General agreement in terms of source spectrum scaling is found between the data and the model with the exception of the longer-periods. Figure 1 summarizes the crux of the

problem, showing that data for the static level of the reduced displacement potential, $\psi\infty$, scales at a significantly higher rate than the model does. In particular, the problem seems to be in the long-period surface-wave data at high yields (Y > 100 kt), for which $\psi(\infty)$'s are computed using estimates of the seismic moment, M_o. A comparable dataset of M_s measurements are found to scale as 1.33logY, while M_s data for lower yields (Y < 100 kt) scale as 0.84logY in much better agreement with the Mueller and Murphy source, which predicts 0.76logY. An upturn in M_s:m_b data at M_s 3.7, m_b 5.5 for NTS (Evernden et al., 1971) is consistent with higher scaling rates in the M_s data at high yields. Hence, the high yield M_s and M_o measurements for NTS explosions are not reconcilable with the long-period scaling predicted by source models of underground nuclear explosions. This paper reviews recent developments that have led to significant gains in analyzing long-period data recorded at regional distances.

4087 (CONF-890398–, pp. 135-142) **P_n from the Nevada Test Site.** Burdick, L.J.; Saikia, C.K.; Smith, N.F. Lawrence Livermore National Lab., CA (United States). 12 May 1989. From DOE/LLNL symposium on explosion-source phenomenology; Lake Tahoe, CA (United States); 14-16 Mar 1989. In *Proceedings of the DOE/LLNL symposium on Explosion-Source Phenomenology.* 251p. Order Number DE89016501. Source: OSTI; NTIS.

A regional event discriminant is being developed and tested based on the wave form of high frequency P_n. The data base being used in the development consists of signals from explosions and earthquakes recorded on the western US digital network. It has been discovered that at most stations the waveform of P_n onset from contained explosions is remarkably stable and different from the corresponding waveforms from earthquakes. Modeling reveals that the distinctive character of their waveform is caused by a strong pP_n arrival. The observed pP_n phase consistently arrives later than the predicted elastic time. For Pahute events, the amplitude of effective pP is close to the elastic predictions. For Yucca Valley, it is consistently larger indicating the effect of a site dependent nonlinear process in the source region. An appropriate value of t^* for P_n appears to be in the range of 0.1 to 0.2 seconds. The frequency content of the explosion P_n energy indicates that it is related to a turning ray in the lid gradient rather than a true head wave traveling on the crust mantle interface. The discrimination capacity of the P_n waveform was measured quantitatively by correlating the average explosion P_n trace with a data base of explosion and earthquake signals. The populations separated to a significant level down to magnitudes less than 4.0. It was found that the average explosion waveform from one station could be used to discriminate data from a different station establishing that the P_n waveform discriminant is transportable.

4088 (CONF-890398–, pp. 143-148) **Broad band estimates of the seismic source functions of explosions from far-field observations of p-waves.** Douglas, A. (Ministry of Defence, Reading (United Kingdom)). Lawrence Livermore National Lab., CA (United States). 12 May 1989. From DOE/LLNL symposium on explosion-source phenomenology; Lake Tahoe, CA (United States); 14-16 Mar 1989. In *Proceedings of the DOE/LLNL symposium on Explosion-Source Phenomenology.* 251p. Order Number DE89016501. Source: OSTI; NTIS.

The paper presents estimates of the seismic source functions of Nevada Test Site (NTS) explosions derived by the deconvolution of the short-period (SP) P seismograms. The procedure used is that of Douglas et al (1987). The SP P seismogram is passed through a filter with a response at frequency ω of $|a_2(\omega)|a_1(\omega)^{-1}b(\omega)^{-1}$, where $a_1(\omega)$ is the response of the recording system, $a_2(\omega)$ the response of a broad-band (BB) system and $b(\omega)$ is the response of the chosen attenuation operator. $|b(\omega)|$ has the form $\exp(-\omega t^*/2)$ where t^*, the ratio of travel time to specific quality factor Q, may be frequency dependent. The phase response of $b(\omega)$ is specified from theoretical considerations to ensure the operator is causal. By using $|a_2(\omega)|$ for the BB response rather than $a_2(\omega)$ all phase shifts due to the recording system are removed. Stewart and Douglas (1983) show that such phaseless seismograms are sometimes easier to interpret than those with the phase shift present. In addition to the filter specified above, further filtering usually has to be applied to attenuate low and high frequency noise.

4089 (CONF-890398–, pp. 149-156) **Near-source scattering of Rayleigh to P waves in teleseismic arrivals of NTS shots.** Gupta, I.N. (Teledyne Geotech, Alexandria, VA (United States)); Jih, R.S.; Wagner, R.A. Lawrence Livermore National Lab., CA (United States). 12 May 1989. From DOE/LLNL symposium on explosion-source phenomenology; Lake Tahoe, CA (United States); 14-16 Mar 1989. In *Proceedings of the DOE/LLNL symposium on Explosion-Source Phenomenology.* 251p. Order Number DE89016501. Source: OSTI; NTIS.

Theoretical and experimental studies indicate that a large amount of ground surface motion in the vicinity of a shallow explosion is contained in surface waves. Greenfield suggested that a significant portion of arrivals in P coda (taken to be between 10 and 40 sec after first P) may be due to near-surface scattering of explosion-generated Rayleigh waves into teleseismic P. Gupta et al. (1985) proposed that near-source scattering of fundamental-mode Rayleigh waves (Rg) into teleseismic P (referred to as Rg → P hereafter) may be responsible for the large arrivals immediately following P and pP on NORSAR records of NTS shots. Gupta and Blandford also found evidence for 'secondary arrivals due to surface interaction phenomena' which showed greater dependence on shot medium velocity than the earlier teleseismic arrivals of P and pP. Several other investigators suggested this later arrival to be the slapdown phase associated with near surface spallation. Two-dimensional linear finite-difference simulations of explosion sources in the Yucca Flats (NTS) by McLaughlin et al. indicated the presence of large secondary arrivals due to scattering of surface waves mainly at offsets in the basement structure and at the sides of the valley. Numerical modeling of explosions within the laterally varying Yucca Flats geological structure by Stead and Helmberger also showed the locally scattered Rayleigh waves to generate large arrivals following P and pP. The preliminary results based on a comparison of the observed and synthetic seismograms of a fairly large number of Pahute Mesa (NTS) shots recorded at NORSAR and EKA provide additional support in favor of the Rg → P scattering mechanism.

4090 (CONF-890398–, pp. 166-176) **The high frequency character of P-wave form earthquakes and explosions.** Walter, W.R. (Univ. of Nevada, Reno (United States)); Priestley, K.F. Lawrence Livermore National Lab., CA (United States). 12 May 1989. From DOE/LLNL symposium on explosion-source phenomenology; Lake Tahoe, CA (United States); 14-16 Mar 1989. In *Proceedings of the DOE/LLNL symposium on Explosion-Source Phenomenology.* 251p. Order Number DE89016501. Source: OSTI; NTIS.

The recent recording of the Soviet Joint Verification Explosion (JVE) at near (180-260) and regional distances (1,300-2,800 km) provides a unique data set to examine the general problem of discriminating between underground nuclear explosions and naturally occurring earthquakes. In particular this explosion can be compared with earthquake data recorded previously at these sites and others which have travel paths wholly or mostly with the USSR. This data will allow a comparison of the excitation and propagation characteristics of regional phases from explosions and earthquakes. The authors present here a preliminary comparison of the Soviet JVE, a Soviet peaceful nuclear explosion (PNE) and an earthquake recorded near the Soviet Kazakh test site with an epicentral distance of 640 km.

4091 (CONF-890398–, pp. 177-179) **Forward-modeling workshop.** Day, S.M. Lawrence Livermore National Lab., CA (United States). 12 May 1989. From DOE/LLNL symposium on explosion-source phenomenology; Lake Tahoe, CA (United States); 14-16 Mar 1989. In *Proceedings of the DOE/LLNL symposium on Explosion-Source Phenomenology.* 251p. Order Number DE89016501. Source: OSTI; NTIS.

The Forward Modeling Working Group identified a number of phenomena which still constitute significant gaps in technical understanding of underground nuclear explosion phenomenology. For example: (1) Inelastic zone response. What is the appropriate formal treatment of the inelastic regime, defined as the regime in which rock response is nonlinear, but stresses are insufficient to cause macroscopic failure? This regime is generally considered to

encompass roughly the strain range 10^{-3} to 10^{-6}. (2) Hydrodynamic yield estimation. Potential scaling problems associated with hydrodynamic yield estimation methods at low yield have not been sufficiently explored. (3) Secondary sources. How does spall effect the seismic signal from Soviet tests? (4) Test geometry. Tunnel shots a low yield need to be better understood from a verification perspective, as do the effects of shooting in or near the shatter zone of a previous test.

4092 (CONF-890398–, pp. 180-181) **Multi-dimensional simulation of nonlinear source processes and seismic wave excitation.** Day, S.M. (San Diego State Univ., CA (United States)); Stevens, J.L.; Rimer, N.; Barker, T.G.; McLaughlin, K.L. Lawrence Livermore National Lab., CA (United States). 12 May 1989. From DOE/LLNL symposium on explosion-source phenomenology; Lake Tahoe, CA (United States); 14-16 Mar 1989. In *Proceedings of the DOE/LLNL symposium on Explosion-Source Phenomenology.* 251p. Order Number DE89016501. Source: OSTI; NTIS.

To support treaty verification, it is desirable to be able to predict regional and teleseismic ground motion from underground tests using nonlinear continuum mechanics (in the near-source region) and synthetic seismogram methods (in the elastodynamic regime). Ideally, such predictive calculations are to be based on field and laboratory characterization of the rock at the test site. To this end, much effort has been expended, both in verification and containment programs, to construct nonlinear constitutive models based on accepted rock mechanics principles. The parameters in these constitutive models are quantities which are, in principle, observable in the laboratory. The reality is, however, that in order to match near-source, free-field ground motion from in situ tests, one generally must adjust the constitutive model parameters to values which often differ significantly from the apparent laboratory values. Thus, calibration of present constitutive models ultimately relies on ground motion data from in situ tests, and therefore the models do not provide a reliable predictive capability for testing environments in which there is no prior experience. Nevertheless, once calibrated with ground motion data, the models provide a basis for investigating the seismic effects introduced by perturbations to the testing geometry. The authors review results from two- and three-dimensional explosion simulations to investigate the seismic effects of (1) variations in the depth of burial, (2) variations in the tectonic prestress, and (3) induced block motion in the source region.

4093 (CONF-890398–, pp. 182-183) **The transition to elastic behavior in the vicinity of an underground explosion.** Minster, J.B.; Day, S.M.; Shearer, P.M. Lawrence Livermore National Lab., CA (United States). 12 May 1989. From DOE/LLNL symposium on explosion-source phenomenology; Lake Tahoe, CA (United States); 14-16 Mar 1989. In *Proceedings of the DOE/LLNL symposium on Explosion-Source Phenomenology.* 251p. Order Number DE89016501. Source: OSTI; NTIS.

It is well known from laboratory experiments that the attenuation of elastic waves is amplitude dependent at strain greater than 10^{-6}. There exists therefore an intermediate strain regime in which the deformation is not strong enough to cause macroscopic material failure, but is large enough to affect wave propagation. For a wide variety of rocks, the amplitude dependence of Q for monochromatic waves at low confining pressure is approximated quite accurately in the strain range 10^{-6} to 10^{-4} by $Q^{-1}(\varepsilon_m) = Q_a^{-1} + \gamma\varepsilon_m$, where ε_m is the strain amplitude and the intercept Q_a^{-1} represents the low amplitude anelastic (that is, linear) attenuation. Because Q depends on amplitude, the rheology is nonlinear, and reflects the influence of inelastic mechanisms. The nonlinear nature of the rheology means that the analytical tools usually employed to solve wave propagation problems are not valid in this intermediate strain regime. This raises a number of questions regarding the acquisition and interpretation of experimental data. Nevertheless, linear analysis of laboratory data which clearly exhibits nonlinear traits is attractive, in the sense that it yields fairly simple and apparently self-consistent results. Furthermore, a reasonable physical interpretation appears feasible. A number of possible physical mechanisms predict an amplitude dependence of attenuation. The latter mechanism appears to satisfy many observations of nonlinear Q in geologic materials.

4094 (CONF-890398–, pp. 205-214) **Differing P and S wave source histories from tectonic release models: A possible complication to second order moment tensor inversions of Rayleigh waves from nuclear explosions.** Harkrider, D.G. Lawrence Livermore National Lab., CA (United States). 12 May 1989. From DOE/LLNL symposium on explosion-source phenomenology; Lake Tahoe, CA (United States); 14-16 Mar 1989. In *Proceedings of the DOE/LLNL symposium on Explosion-Source Phenomenology.* 251p. Order Number DE89016501. Source: OSTI; NTIS.

A frequently used model of tectonic release is a double couple superimposed on an explosion. The author compares synthetics of this and more realistic models in order to investigate the effect of the dimensions of the tectonic release model or equivalently the effect of differing P and S wave source histories. For instance, the pure shear cavity release model is a double couple with separate P wave and S wave source histories. The time scales are proportional to the source region's dimension and differ by their respective body wave velocities.

4095 (CONF-890398–, pp. 215-230) **Radiation patterns from explosions in anisotropic media.** Mandal, B. (Massachusetts Inst. of Tech., Cambridge (United States)); Toksoez, M.N. Lawrence Livermore National Lab., CA (United States). 12 May 1989. From DOE/LLNL symposium on explosion-source phenomenology; Lake Tahoe, CA (United States); 14-16 Mar 1989. In *Proceedings of the DOE/LLNL symposium on Explosion-Source Phenomenology.* 251p. Order Number DE89016501. Source: OSTI; NTIS.

The primary objective of this study is to determine the effect of seismic anisotropy on the radiation patterns from an explosion in the anisotropic medium by calculating the complete synthetic seismograms. Theoretical seismograms show that radiation patterns are strongly affected by the anisotropy. An explosion in an anisotropic medium with horizontal axes of symmetry generates P, SV and Rayleigh waves whose amplitudes vary with azimuth, and significant transverse (SH) waves at certain azimuths. These effects could be explained by the non-spherical source due to the direction dependence of elastic moduli and by the complicated reflection and conversion phenomena of waves propagating in the anisotropic media.

4096 (CONF-890398–, pp. 231-232) **Geological models in 1-D and 2-D nuclear event calculations that influence surface motion and spall.** Rambo, J.T. Lawrence Livermore National Lab., CA (United States). 12 May 1989. From DOE/LLNL symposium on explosion-source phenomenology; Lake Tahoe, CA (United States); 14-16 Mar 1989. In *Proceedings of the DOE/LLNL symposium on Explosion-Source Phenomenology.* 251p. Order Number DE89016501. Source: OSTI; NTIS.

Modeling the surface motions generated by nuclear sources can help with Treaty Verification issues, such as yield estimation and discrimination. Over the last fifteen years, researchers have studied the Nevada Test Site (NTS) event sites by making 1-D and 2-D containment related calculations that simulate a variety of geologic and material models. They found that surface motions are influenced by yield, depth of burial, and material properties, both at the source and toward the surface. Since depth of burial and yield are usually known, material property modeling is of main interest. The two properties primarily influencing calculated surface motion are gas porosity and elastic strength. There are combinations of these parameters from the working point to the surface that can have a large affect on the ground motion. The author has made multiple calculations to test material property sensitivities to surface motion. Calculations and experimental data have been very useful in demonstrating the phenomena of focusing from a water table. He discusses two sites: one site from which most data were taken from the subsurface with a single station at the surface, and the second site from which all data were taken with a surface array of velocity gauges.

4097 (CONF-890398–, pp. 233-240) **Simulation of regional seismograms, teleseismic body waves, and Rayleigh wave phase shifts using two-dimensional nonlinear models of explosion sources.** Stevens, J.L. (S-Cubed, La Jolla, CA (United States)); McLaughlin, K.L.; Day, S.M.; Shkoller, B.; Barker, T.

Lawrence Livermore National Lab., CA (United States). 12 May 1989. From DOE/LLNL symposium on explosion-source phenomenology; Lake Tahoe, CA (United States); 14-16 Mar 1989. In *Proceedings of the DOE/LLNL symposium on Explosion-Source Phenomenology.* 251p. Order Number DE89016501. Source: OSTI; NTIS.

Two-dimensional nonlinear simulations of underground nuclear explosions have been coupled to wave propagation codes to generate synthetic seismograms from complex source models. Two-dimensional simulations were performed for a range of depths in Shagan River and Pahute Mesa earth models. Simulations in granite were performed with and without tectonic prestress. During each of these calculations, the displacements and stresses were saved on a monitoring surface surrounding the nonlinear region. Two-dimensional Green's functions were calculated for each point on the monitoring surface, and the displacements and stresses were integrated to determine the ground motion at a receiver. Green's functions were calculated for far body waves, for fundamental mode surface waves, and for complete regional waveforms. The regional Green's functions were calculated using wave number integration.

4098 (CONF-890398–, pp. 243-251) **Three-dimensional simulations of ripple-fired quarry blasts in Massachusetts.** Wojcik, G.L. (Weidlinger Associates, Los Altos, CA (United States)); Vaughan, D.K. Lawrence Livermore National Lab., CA (United States). 12 May 1989. From DOE/LLNL symposium on explosion-source phenomenology; Lake Tahoe, CA (United States); 14-16 Mar 1989. In *Proceedings of the DOE/LLNL symposium on Explosion-Source Phenomenology.* 251p. Order Number DE89016501. Source: OSTI; NTIS.

This talk describes some numerical model simulations of the San Vel Quarry experiment in Littleton, Massachusetts, performed during the summer of 1987 by Stump, et al. (1987) and AFGL, MIT, and Boston College researchers. These simulations are intended to support continuing field work on quarry explosion source effects as they pertain to Test Ban Treaty verification, involving Stump at SMU, Reinke of the AFWL, and others in the AFGL/DARPA Program. The ultimate aim of this work is to gain a better understanding of conventional quarry blast source effects in terms of shot distribution and sequencing, as well as local topography and geology. There are a number of approaches available for understanding this complex phenomenon including (1) conventional layered half-space interpretation, (2) field data acquisition and interpretation, (3) physical model experiments, and (4) numerical experiments. Since the quarry is three-dimensional with a very nonuniform surface, i.e., a big hole in the ground, conventional half-space methods are inadequate, leaving field data and models as the best source of insight. The principal issue addressed here is the practicality of using large-scale, 3-D finite element model analysis as a method of both understanding and generalizing quarry-derived near-field data.

4505 Strategic Defense Initiative

4099 (CONF-890398–, pp. 6-12) **Free-field observations from underground nuclear explosions.** Murphy, J.R. (S-Cubed, Reston, VA (United States)). Lawrence Livermore National Lab., CA (United States). 12 May 1989. From DOE/LLNL symposium on explosion-source phenomenology; Lake Tahoe, CA (United States); 14-16 Mar 1989. In *Proceedings of the DOE/LLNL symposium on Explosion-Source Phenomenology.* 251p. Order Number DE89016501. Source: OSTI; NTIS.

In spite of the experimental difficulties which have been briefly illustrated in this paper, much valuable free-field ground motion data have been recorded during the course of the US underground testing program. Table 1 lists the explosions conducted prior to about 1970 for which reduced displacement potentials have been estimated from subsurface recordings and published in various post-shot reports and summary documents (Perret and Bass, 1975; Murphy, 1978; Murphy and Bennett, 1979). It can be seen that a variety of different source media are represented, including salt, granite, dolomite, sandstone/shale, wet and dry tuff and wet and dry alluvium. These data represent a unique resource for evaluating the dependence of seismic source coupling on emplacement medium and for the calibration of theoretical models of the explosive source. However, due to complications associated with medium heterogeneity such as those illustrated in Figures 1 and 2, this potential has never been fully realized. Given the advances in computer and material modeling capability which have occurred over the past decade, it may now be feasible to reinvestigate some of these data using more realistic propagation path models and thereby obtain improved insight into the explosive seismic source function.

4100 (CONF-890398–, pp. 44-51) **Freefield data and the seismic source function: New source parameter results.** Denny, M.D. Lawrence Livermore National Lab., CA (United States). 12 May 1989. From DOE/LLNL symposium on explosion-source phenomenology; Lake Tahoe, CA (United States); 14-16 Mar 1989. In *Proceedings of the DOE/LLNL symposium on Explosion-Source Phenomenology.* 251p. Order Number DE89016501. Source: OSTI; NTIS.

In an effort to better understand the seismic source function, the author began a study of failure mechanisms and of source parameter estimation techniques. Some results from the study of failure mechanisms by numerical simulation are presented by Lew Glenn. In this paper some new source parameter results obtained from freefield data are presented.

4506 Chemical and Biological

Refer also to citation(s) 3563, 4224

54 ENVIRONMENTAL SCIENCES

Refer also to citation(s) 3482, 4361, 4806

4101 (DOE/RL–92-37) **1991 toxic chemical release inventory: Emergency Planning and Community Right-To-Know Act of 1986, Section 313.** USDOE Richland Operations Office, WA (United States). Jul 1992. 21p. Sponsored by USDOE, Washington, DC (United States). Order Number DE93001450. Source: OSTI; NTIS; GPO Dep.

The Emergency Planning and Community Right-To-Know Act of 1986 (EPCRA) requires the annual submittal of toxic chemical release information to the US Environmental Protection Agency (EPA). This document, known as the EPCRA (SARA) 313 Report, is the July 1992 submittal of EPA's Form R for the chemicals manufactured, processed, or otherwise used in excess of the established regulatory thresholds at the Hanford Site by the US Department of Energy, Richland Field Office and its contractors during calendar year 1991.

4102 (ETDE-mf–93728688) **Research on the protection of tropical forests in Brazil.** BMFT - Pressedokumentation. Bundesministerium fuer Forschung und Technologie, Bonn (Germany). 17 Jan 1992 48p. (In German). Order Number DE93728688. Source: OSTI; NTIS (US Sales Only).

This press documentation reports on two projects: 1. The research programme of the Federal Ministry of Science and Technology on ecology of the tropics (Studies on Human Impact on Forest and Floodplains in the Tropics - SHIFT); 2. A concept for a 'tropical forest research programme Brazil' to be carried through jointly by BMFT and BMZ (Federal Ministry of Economic Cooperation). (orig.).

4103 (INIS-mf–13376, pp. 1-56) **Influence of nuclear power plant accident at Chernobyl on radiological situation in Poland.** Grabowski, D. (Centralne Lab. Ochrony Radiologicznej, Warsaw (Poland)). National Atomic Energy Agency, Warsaw (Poland). Apr 1990. 60p. (In Polish). In *Four years after nuclear power plant accident at Chernobyl.* Order Number DE93607099. Source: OSTI; NTIS (US Sales Only); INIS.

The contamination during and after the accident as well as radiological threat in Poland are described. Many statistical data are given. The data are compared. 7 figs., 33 tabs. (A.S.).

5401 Environmental Sciences, Atmospheric

Refer also to citation(s) 2516, 2519, 2615, 2733, 2742, 2760, 2832, 2834, 2835, 2836, 2837, 2947, 2972, 2973, 2976, 3028, 3083, 3084, 3085, 3086, 3087, 3466, 3529, 3534, 3537, 3797, 4182, 4196, 4197, 4198, 4202, 4212, 4214, 4236, 4237, 4238, 4364, 4367, 4369, 4370, 4387, 4412, 4785

4104 (AECS-PR/RTW–17) **The communications in early warning network for radiation monitoring.** Oyoun, M.B. (Atomic Energy Commission, Damascus (Syrian Arab Republic)); Al-Hussin, Mohamad; Fares, Adnan; Al-Oulabi, Yasser; Othman, Ibrahim. Atomic Energy Commission, Damascus (Syrian Arab Republic). Jul 1992. 37p. (In Arabic). Order Number DE93607156. Source: OSTI; NTIS (US Sales Only); INIS.

The objectives of early warning network are: The determination of gamma radiation (background) levels in air which depend on location and time, evaluation of any situation resulting from radiation or nuclear accident out of boarder, and after that reporting the emergency situation to relevant authorities on the national and international levels. Monitoring stations were installed using Gm tubes to cover boarder lines from south to north and east to west as follows: Damascus, Darra, Latakia, Tartous, Aleppo, Kamishly, Ragaa, and Qunitra. The following modes of communication: Telephone line, leased line, direct connection, and Syrian data network were used in the Syrian early network. This project was carried out in cooperation with IAEA under project no. RER/9/003. (author). 22 figs., 1 tab.

4105 (ANL/CP–76983) **AQUIS: A PC-based air quality and permit information system.** Smith, A.E. (Argonne National Lab., IL (United States)); Huber, C.C.; Tschanz, J.; Ryckman, J.S. Jr. Argonne National Lab., IL (United States). [1992]. 13p. Sponsored by Department of Defense, Washington, DC (United States). DOE Contract W-31109-ENG-38. (CONF-9209160–20: International symposium on energy, environment and information management, Argonne, IL (United States), 15-18 Sep 1992). Order Number DE92040092. Source: OSTI; NTIS; INIS; GPO Dep.

The Air Quality Utility Information System (AQUIS) was developed to calculate and track emissions, permits, and related information. The system runs on IBM-compatible personal computers using dBASE IV. AQUIS tracks more than 900 data items distributed among various source categories and allows the user to enter specific information on permit control devices, stacks, and related regulatory requirements. The system is currently operating at seven US Air Force Materiel Command facilities, large industrial operations involved in the repair and maintenance of aircraft. Environmental management personnel are responsible for the compliance status of as many as I,000 sources at each facility. The usefulness of the system has been enhanced by providing a flexible reporting capability that permits users who are unfamiliar with database structure to design and prepare reports containing specified information. In addition to the standard six pollutants, AQUIS calculates compound-specific emissions and allows users to enter their own emission estimates. This capability will be useful in developing air toxics inventories and control plans.

4106 (ANL/CP–77199) **Global environmental security: Research and policy strategies for the 1990s.** Lazaro, M.A.; Wang, Hua. Argonne National Lab., IL (United States). [1992]. 10p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-31109-ENG-38. (CONF-9209160–11: International symposium on energy, environment and information management, Argonne, IL (United States), 15-18 Sep 1992). Order Number DE92040095. Source: OSTI; NTIS; INIS; GPO Dep.

The subject of global environmental change is emerging as one of the most hotly debated international issues for the 1990s. In fact, our earth system has undergone a nature-induced gradual change in climate on both a temporal scale that spans over millions of years and a spatial scale ranging from regional to transcontinental. Pollutant emissions associated with population growth and industrial activities manifest the anthropogenic climatic forcing that has been superimposed on the background of natural climate fluctuations. Our incomplete understanding of the global impacts of environmental pollution on the earth systems (atmosphere, biosphere, hydrosphere, cryosphere, and lithosphere), however, make the prediction of the timing, magnitude, and patterns of future global change uncertain. This paper examines the science and policy background of global environmental change. The major scientific uncertainties and policy issues confronting decision makers are identified; and the scientific framework, as well as current national and international research programs aimed at resolving the scientific uncertainties, are discussed. A coherent, stable, and flexible policy is needed to provide a foundation for coordinated international-interagency programs of observation, research, analysis, and international negotiation toward a policy consensus concerning global environmental security. On the basis of what is currently known about global change, recommendations are presented on both near-term and long-term policy option decisions.

4107 (ANL/CP–77379) **Status of instrumentation for the Southern Great Plains Clouds and Radiation Testbed.** Wesely, M.L. Argonne National Lab., IL (United States). [1991]. 7p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-31109-ENG-38. (CONF-9110430–1: 1991 atmospheric radiation measurement science team meeting, Washington, DC (United States), 28 Oct 1991). Order Number DE93000512. Source: OSTI; NTIS; GPO Dep.

Planning for the initial complement of instrumentation at the first Clouds and Radiation Testbed (CART) site has concentrated on obtaining a sufficient level of instrumentation at the central facility for studies of radiative transfer processes in a narrow column above the site. The auxiliary facilities, whose sole purpose is cloud mapping above the central facility, will not be activated as such until provisions are made for all-sky imaging systems. In the meantime, the auxiliary facilities wig be instrumented as extended facilities if the locations are suitable, which would be the case if they serve the primary purpose of the extended facilities of obtaining representative observations of surface energy exchanges, state variables, precipitation, soil and vegetative conditions, and other factors that must be considered in terms of boundary conditions by single-column and related models. The National Oceanic and Atmospheric Administration (NOAA) radar wind profiler network is being considered to provide observations of vertical profiles at the boundaries of the CART site. If possible, these locations will be used for boundary facilities. Efforts are proceeding to gain access to the wind profiler network data and to determine if a sufficient number of the profilers can be equipped as Radio Acoustic Sounding Systems (RASS). Profiles of temperature as well as winds are needed at the boundary facilities for studies with single-column models and four-dimensional data assimilation models. Balloon-home sounding systems will be used there initially for both temperature and moisture profiles. Infrared spectrometers will eventually be used to infer moisture profiles at these boundary facilities.

4108 (BNL–47743) **Fractional activation of accumulation-mode particles in warm continental stratiform clouds.** Gillani, N.V. (Gillani (N.V.) & Associates, Inc., St. Louis, MO (United States)); Daum, P.H.; Schwartz, S.E.; Leaitch, W.R.; Strapp, J.W.; Isaac, G.A. Brookhaven National Lab., Upton, NY (United States). Jul 1991. 15p. Sponsored by USDOE, Washington, DC (United States); Electric Power Research Inst., Palo Alto, CA (United States); Canadian Inst. for Aerospace Research (Canada). DOE Contract AC02-76CH00016. (CONF-9107104–24: 5. international conference on precipitation scavenging and atmosphere surface exchange process, Richland, WA (United States), 15-19 Jul 1991). Order Number DE93001981. Source: OSTI; NTIS; INIS; GPO Dep.

The degree of activation of accumulation-mode particles (AMP) in clouds has been studied using continuous (1 second average) aircraft measurements of the number concentrations of cloud droplets (N_{cd}, 2 to 35 μm diameter) and of unactivated AMP (N_{amp}, 0.17 to 2.07 μm diameter) in cloud interstitial air. The magnitude and spatial variation of the activated fraction (F) of all measured particles (defined as $F \equiv N_{cd}/N_{tot}$, where $N_{tot} = N_{cd} + N_{amp}$) are investigated, based on measurements made during ten aircraft flights in non-precipitating warm continental stratiform clouds near Syracuse NY in the fall of 1984. Based on instantaneous observations throughout the clouds, the spatial distribution of F was found to be quite nonuniform. In general, F was low in cloud edges and where total particle loading was high and/or cloud convective activity was low. In the interior of clouds, the value of F exceeded 0.9 for 36%

of the data, but was below 0.6 for 28%. Factors influencing F the most were the total particle loading (N_{tot}) and the thermal stability of the cloud layer. The dependence of F on N_{tot} in cloud interior was characterized by two distinct regimes. For $N_{tot} < 600$ cm^{-3}, F was generally close to unity and relatively insensitive to N_{tot}. For $N_{tot} >$ 800 cm^{-3}, F tended to decrease with increasing N_{tot}. This decrease was greatest in a stable stratus deck embedded in a warm moist airmass. The results suggest that, in warm continental stratiform clouds, the process of particle activation becomes nonlinear and self-limiting at high particle loading. The degree of this nonlinearity depends on cloud convective activity (thermal instability).

4109 (BNWL-SA-4676) **Analysis of an analytical technique for distributing air sampling locations around nuclear facilities.** Waite, D.A. Pacific Northwest Lab., Richland, WA (United States). May 1973. 9p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. (CONF-730907-1: 3. international congress of the International Radiation Protection Association meeting, Washington, DC (United States), 9-14 Sep 1973). Order Number DE93000315. Source: OSTI; NTIS; GPO Dep.

A new analytical mechanism for distributing air sampling locations around nuclear facilities, including reactors, fuel fabrication, fuel reprocessing and research centers, has been devised. This method was developed to facilitate the efficient incorporation of past experiences into environmental surveillance programs for now or developing installations. The technique provides an initial distribution of air samplers around a site which correlates well with placements on sites which have been occupied by long established programs with their inherent evolution and refinements. The applicability of this approach has been examined by comparing sampling locations in well-established air monitoring programs scattered worldwide with location distributions recommended by this mechanism. Results of these comparisons will be detailed.

4110 (CLOR-121/D) **The system for measurements of radioactive contamination of environment and food in Poland.** Grabowski, D.; Kurowski, W. Centralne Lab. Ochrony Radiologicznej, Warsaw (Poland). 1990. 7p. Order Number DE93607158. Source: OSTI; NTIS (US Sales Only); INIS.

Report received in March 1992.

The service for Measurements of Radioactive Contamination comprises a network of 152 measuring stations. They are carrying out continuous measurements of gamma radiation dose rates and radioactivity measurements of 24 hours samples of air (aerosols) and total fallout. On the territory of each province there are selected points for sampling of environmental materials and food. Frequency of sampling depends on material being collected. 1 tab., 2 figs. (A.S.).

4111 (CONF-910550-, pp. 681-692) **Growth characteristics of microalgae in high-concentration CO_2 gas, effects of culture medium trace components, and impurities thereon.** Negoro, M. (Takasago Research and Development Center, Takasago (Japan)); Shioji, N.; Ikuta, Y.; Makita, T.; Uchiumi, M. National Renewable Energy Lab., Golden, CO (United States); Oak Ridge National Lab., TN (United States). 1992. From 13. symposium on biotechnology for fuels and chemicals; Colorado Springs, CO (United States); 6-10 May 1991. In *Thirteenth symposium on biotechnology for fuels and chemicals: Proceedings.* 846p. Source: The Humana Press, Inc., Totowa, NJ 07511 (United States).

In order to reduce release of CO_2 contained in the flue gas from a power plant, the authors assumed a system in which the flue gas was directly blown into a pond and CO_2 was fixed on microalgae. The authors have experimentally examined the basic growth characteristics, such as trace components of culture medium, effects of impurities from exhaust gas, and light utilization rate of algal productivity, mainly for Nonnochloropsis sp. NANNP-2 from SERI collection. Although Ni and V contained in heavy oil burnt ashes dissolve into culture solution, their concentrations are low, and they have no particular adverse effect on growth as impurities. Culture medium trace component (i.e., heavy metals and vitamins) are essential for the NANNP-2. However, for the PHAEO-2 (Phaeodactylum sp.), the growth rate hardly changes, even if vitamins and heavy metals other than Fe are eliminated.

4112 (CONF-9109358-, pp. 19) **Accumulation and translocation of chemicals in the Polesie Lubelskie region.** Chimielewski, T.J. (Institute of Spatial and Municipal Management, Lublin (Poland)); Pawlowski, L.; Radwan, S. USDOE, Washington, DC (United States). [1991]. From 8. international conference on chemistry for protection of the environment; Lublin (Poland); 16-18 Sep 1991. In *Chemistry for protection of the environment, Eight international conference: Proceedings.* 635p. Order Number DE92014317. Source: OSTI; NTIS; INIS.

In the literature dealing with accumulation and translocation of pollutants in the environment, of main concern are phenomena occurring in selected components of the environment (air-water, water-soil, water-sediments, soil-plants, selected plant and animal species) in the given area. The usual objects of studies are: a river, lake or water reservoirs, a partial catchment basin, a selected species or a group of species, a definite cultivation area, a selected urbanized area or its part. There are a large number a papers concerning the content and circulation of pollutants inside a single ecosystem; those dealing with accumulation and translocation of pollutants in differentiated polyecosystemic configurations, in the ecological landscape of physiocenoses are much less numerous. This paper presents a preliminary account concerning the accumulation and translocation pathways of selected chemicals in physiocenoses on the margin of two physiographic micro regions.

4113 (CONF-930133-2) **The global historical climatology network: Long-term monthly temperature, precipitation, and pressure data.** Vose, R.S. (Oak Ridge National Lab., TN (United States)); Schmoyer, R.L.; Peterson, T.C.; Steurer, P.M.; Heim, R.R. Jr.; Karl, T.R.; Eischeid, J.K. Oak Ridge National Lab., TN (United States). [1992]. 7p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. From 73. American Meteorological Society (AMS) annual meeting; Anaheim, CA (United States); 17-22 Jan 1993. Order Number DE92041261. Source: OSTI; NTIS; INIS; GPO Dep.

Interest in global climate change has risen dramatically during the past several decades. In a similar fashion, the number of data sets available to study global change has also increased. Unfortunately, many different organizations and researchers have compiled these data sets, making it confusing and time consuming for individuals to acquire the most comprehensive data. In response to this rapid growth in the number of global data sets, DOE's Carbon Dioxide Information Analysis Center (CDIAC) and NOAA's National Climatic Data Center (NCDC) established the Global Historical Climatology Network (GHCN) project. The purpose of this project is to compile an improved data set of long-term monthly mean temperature, precipitation, sea level pressure, and station pressure for as dense a network of global stations as possible. Specifically, the GHCN project seeks to consolidate the numerous preexisting national-, regional-, and global-scale data sets into a single global data base; to subject the data to rigorous quality control; and to update, enhance, and distribute the data set at regular intervals. The purpose of this paper is to describe the compilation and contents of the GHCN data base (i.e., GHCN Version 1.0).

4114 (DOE/ER-0565T) **Global change research: Summaries of research in FY 1992.** USDOE Office of Energy Research, Washington, DC (United States). Office of Health and Environmental Research. Oct 1992. 196p. Sponsored by USDOE, Washington, DC (United States). Order Number DE93002859. Source: OSTI; NTIS; GPO Dep.

Greenhouse gases result from both natural and man-made processes and include carbon dioxide (CO_2), nitrogen oxides (N_xO_y), methane, chlorofluorocarbons, halogenated compounds, water vapor, and others. Since the industrial revolution, the atmospheric concentrations of several greenhouse gases have been increasing, primarily because of human activities. These increases have the potential to cause global climate change through increased radiative forcing. Global climate change is a significant issue for the Department of Energy (DOE) because energy production and use now contribute more than half of the total man-made emissions of greenhouse gases on a global basis. The missions of the Department's Global Change Research Program are: To predict the future atmospheric concentrations of CO_2 and other energy-related greenhouse gases; to predict the future and magnitude of potential

climate change caused by the enhanced greenhouse effect; to understand both the direct impacts of greenhouse-gas emissions on biota and the indirect consequences produced by climate change; to assess the impacts of global climate change on energy systems and energy demand; and to develop and assess the potential of mitigation and adaptation technologies and practices to offset or limit the impact of any potential climate change or to facilitate natural and societal adjustment to the environmental, social, and economic consequences of global climate changes. The information produced by these activities is necessary in order to assess the economic and environmental costs and benefits of both potential climate change caused by the effects of greenhouse gases and implementing different technologies and energy-policy options aimed at preventing, mitigating, or adapting to such change. This document describes the activities and products of the Global Change Research Program in FY 1992.

4115 (DOE/ER/13838–5) **Lagrangian analysis of contaminant dispersal in bounded turbulent shear flows: Progress report, February 1, 1992–January 31, 1993.** Bernard, P.S.; Wallace, J.M.; Balint, J.L. Maryland Univ., College Park, MD (United States). [1992]. 7p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG05-88ER13838. Order Number DE93002794. Source: OSTI; NTIS; GPO Dep.

Laboratory experiments and direct numerical simulations (DNS) of passive scalar contaminant disperal in bounded shear flows have been carried out. Several modifications to the laboratory windtunnel have been carried out which will make possible laser sheet flow visualization along the whole length of the 8m test section. Backward particle paths needed to perform a Lagrangian analysis of scalar transport are in the process of being computed for each of the numerical data sets previously described. A light sheet system is being implemented which is capable of visualizing a 30cm X 30cm X 5cm portion of the wall layer in order to extract quantitative information about the structure of the scalar plumes.

4116 (DOE/ER/60397–6) **Detection of greenhouse-gas-induced climatic change: Progress report, 1 December 1991–30 June 1992.** Wigley, T.M.L.; Jones, P.D. East Anglia Univ., Norwich (United Kingdom). Climatic Research Unit. 15 Jul 1992. 25p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG02-86ER60397. Order Number DE93003149. Source: OSTI; NTIS; INIS; GPO Dep.

The aims of the US Department of Energy's Carbon Dioxide Research Program are to improve assessments of greenhouse-gas-induced climatic change and to define and reduce uncertainties through selected research. This project will address: The regional and seasonal details of the expected climatic changes; how rapidly will these changes occur; how and when will the climatic effects of CO_2 and other greenhouse gases be first detected; and the relationships between greenhouse-gas-induced climatic change and changes caused by other external and internal factors. The present project addresses all of these questions. Many of the diverse facets of greenhouse-gas-related climate research can be grouped under three interlinked subject areas: modeling, first detection and supporting data. This project will include the analysis of climate forcing factors, the development and refinement of transient response climate models, and the use of instrumental data in validating General Circulation Models (GCMs).

4117 (DOE/ER/60485–4) **Natural and anthropogenic climate change: Progress report, [September 1, 1991–March 31, 1992].** Ko, M.K.W. (Atmospheric and Environmental Research, Inc., Cambridge, MA (United States)); Clough, S.A.; Molnar, G.I.; Iacono, M.; Wang, W.C. Atmospheric and Environmental Research, Inc., Cambridge, MA (United States). Mar 1992. 10p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG02-86ER60485. Order Number DE93003150. Source: OSTI; NTIS; INIS; GPO Dep.

This report consists of two parts: (1) progress for the period 9/1/91–3/31/92 and (2) the plan for the remaining period 4/1/92–8/31/92. The project includes two tasks: atmospheric radiation and improvement of climate models to evaluate the climatic effects of radiation changes. The atmospheric radiation task includes four subtasks: (1) Intercomparison of Radiation Codes in Climate Models (ICRCCM), (2) analysis of the water vapor continuum using line-by-line calculations to develop a parameterization for use in climate models, (3) parameterization of longwave radiation and (4) climate/radiation interactions of desert aerosols. Our effort in this period is focused on the first three subtasks. The improvement of climate models to evaluate the subtasks: (1) general circulation model study and (2) 2- D model development and application.

4118 (DOE/ER/61062–T1) **[Multifractal cloud properties data assessment].** Gautier, C. (California Univ., Santa Barbara, CA (United States)); Ricchiazzi, P.; Peterson, P.; Lavallee, D.; Frouin, R.; Lubin, D.; Lovejoy, S.; Schertzer, D. California Univ., Santa Barbara, CA (United States). 6 May 1992. 15p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG03-90ER61062. Order Number DE93002638. Source: OSTI; NTIS; GPO Dep.

Our group has been very active over the last year, analyzing a number of data sets to characterize multifractal cloud properties and assess the effects of clouds on surface radiation properties (spectral and broadband). The data sets analyzed include: AVHRR observations of clouds over the ocean, SPOT observations of clouds over the ocean, SSM/I observations of clouds over the ocean, pyranometer data with all-sky photographs, pyrgeometer data all-sky photographs, and spectral surface irradiance all-sky photographs. A number of radiative transfer computations have been performed to help in the interpretation of these observations or provide theoretical guidance for their analysis. Finally 4 number of radiative transfer models have been acquired and tested to prepare for the interpretation of ARM/CART data.

4119 (DOE/ER/61364–1) **Use of cloud observations and mesoscale meteorology models to evaluate and improve cloud parameterizations: Technical progress report, 1 December 1991–30 November 1992.** Walcek, C.J. State Univ. of New York, Albany, NY (United States). Atmospheric Sciences Research Center. 30 Oct 1992. 5p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG02-92ER61364. Order Number DE93003245. Source: OSTI; NTIS; GPO Dep.

This research program utilizes satellite and surface-derived cloud observations together with standard meteorological measurements to evaluate and improve our ability to accurately diagnose cloud coverage. Results are to be used to compliment existing or future parameterizations of cloud effects in general circulation models, since nearly all cloud parameterizations must specify a fractional area of cloud coverage when calculating radiative or dynamic cloud effects, and current parameterizations rely on rather crude cloud cover estimates. We have compiled and reviewed a list of formulations used by various climate research groups to specify cloud cover. We find considerable variability between formulations used by various climate and meteorology models, and under some conditions, one formulation will produce a zero cloud amount, while an alternate formulation calculates 95% cloud cover under the same environmental conditions. All formulations hypothesize that cloud cover is predominantly determined by the average relative humidity, although some formulations allow local temperature lapse rates and vertical velocities to influence cloud amount.

4120 (DOE/ER/61365–1) **ARM Fourier transform spectrometer data analysis tools.** Smith, W.L. Wisconsin Univ., Madison, WI (United States). [1992]. 10p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG02-92ER61365. Order Number DE93004648. Source: OSTI; NTIS; GPO Dep.

This is the first year mid-term report. Ground-based meteorological field experiments similar to AERI, are serving as the data base for the development of analysis tools sprior to AERI installation at the ARM CART site: SPETRE, STORMFEST, and Pt Sur 92. Objectives are to improve infrared radiative transfer models under clear and cloud conditions, develop a method of inferring effective cloud optical properties from FTIR observations, model effects of cloud properties on radiative properties for interpreting FTIR observations and developing remote sensing, develop a classification method for spectral radiances for atmospheric radiative transfer studies, and develop algorithms for retrieving temperature and constituent profiles from FTIR. 3 figs.

4121 (DOE/ER/69017–4) **Diagnostic studies of climate variability: Annual report, December 1, 1991–November 30,**

1992. Bradley, R.S. (Massachusetts Univ., Amherst, MA (United States)); Diaz, H.F. Massachusetts Univ., Amherst, MA (United States). [1992]. 12p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG02-89ER69017. Order Number DE93002837. Source: OSTI; NTIS; GPO Dep.

This paper reports on the progress on the first year of the diagnostic studies of climate variability project. The objectives were as follows: to initiate studies of long-term climatic variability, using long instrumental data sets, and proxy records; to examine regional changes of temperature and precipitation over the past century in relation to changes at the hemispheric and global scale; and to produce a map-based archive of monthly and seasonal temperature, precipitation and pressure data fore display on PCs. Significant progress has been made in all of these areas. This paper summarizes results of the work accomplished. Part A summarizes results of the work accomplished. Part A summarizes the work accomplished primarily at the University of Massachusetts. Part B summarizes work primarily conducted at NOAA/ERL. A list of papers published, in press, or in preparation then follows. Appendix 1 is a description of the proposed research in 1992–93, and a proposed budget.

4122 (DOE/NV/10594–T2) **A guide to archival collections relating to radioactive fallout from nuclear weapon testing: Ninth edition.** Martin, B.W. (ed.). History Associates, Inc., Rockville, MD (United States). Sep 1992. 98p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC08-87NV10594. Order Number DE93000909. Source: OSTI; NTIS; INIS; GPO Dep.

This ninth edition of A Guide to Archival Collections Relating to Radioactive Fallout from Nuclear Weapon Testing constitutes History Associates Incorporated's (HAI) final report of its document collection, processing, and declassification efforts for the Nevada Field Office of the Department of Energy. The most significant feature of this edition is the updated HAI collection effort information. We confirmed the accuracy of this information using our screening, processing, and transmittal records. Unlike previous editions, funding limitations prevented us from systematically revising the collection descriptions and point-of-contact information for this final edition. This guide has been prepared by professional historians who have a working knowledge of many of the record collections included in the following pages. In describing materials, they have tried to include enough information so that persons unfamiliar with the complexities of large record systems will be able to determine that nature of the information in, and the quality of, each record collection.

4123 (DOE/NV/10630–37) **Operational air sampling report, July–December 1991.** Lyons, C.L. Reynolds Electrical and Engineering Co., Inc., Las Vegas, NV (United States). Nov 1992. 22p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC08-89NV10630. Order Number DE93003155. Source: OSTI; NTIS; INIS; GPO Dep.

Air sampling is one of the more useful ways of assessing the effectiveness of operational radiation safety programs at the Nevada Test Site (NTS). Air sampling programs document NTS airborne radionuclide concentrations in various work locations and environments. These concentrations generally remain well below the Derived Air Concentration (DAC) values prescribed by the Department of Energy (DOE 5480.11, Attachment 1) or the Derived Concentration Guide (DCG) values prescribed by the Department of Energy DOE 5400.5, Chapter III. The Defense Nuclear Agency (DNA) tunnel complexes, Area 12 Test Support Compound and the Area 6 Decontamination Pad and Laundry air sampling programs are summarized in this report. Evaluations are based on Analytical Services Department (ASD) Counting Laboratory analyses and Health Protection Department (HPD)/Radiological Field Operations Section (RFOS) radiation protection technician's (RPT) or health physicists' calculations for air samples collected July 1 through December 31, 1991. Of the NTS operational air sampling programs in the tunnel complexes, the initial mining and event reentry and recovery operations represent the only real airborne radioactive inhalation potentials to personnel. Monthly filter and scintillation cell samples were taken and counted in RDA-200 Radon Detectors to document working levels of radon/thoron daughters and picocurie/liter (PCVL) concentrations of radon gas. Weekly Drierite samples for tritium analysis were taken in the active tunnel complexes to document any changes in normal background levels or reentry drifts as they are advanced toward ground zero (GZ) areas. Underground water sources are considered primary transporters of tritium from old event areas.

4124 (DOE/NV/10630–42) **Operational air sampling report, January–June 30, 1992.** Lyons, C.L. Reynolds Electrical and Engineering Co., Inc., Las Vegas, NV (United States). Sep 1992. 18p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC08-89NV10630. Order Number DE93004380. Source: OSTI; NTIS; INIS; GPO Dep.

Nevada Test Site postshot and tunnel events generate beta/gamma fission products. The Reynolds Electrical & Engineering Co., Inc. air sampling program is designed for measurement of these radionuclides at various facilities supporting these events. Monthly radon sampling is done for documentation of working levels in the tunnel complexes, which would be expected to hove the highest radon levels for on-site facilities. Out of a total of 281 air samples taken in the tunnel complexes, 25 showed airborne fission products with concentrations well below their respective Derived Air Concentrations (DAC). All of these were related to event reentry or mineback operations. Tritiated water vapor and radon levels were very similar to previously reported levels. The 975 air samples taken at the Area-6 decontamination bays and laundry were again well below any DAC calculation standard and negative for any airborne fission products from laboratory analyses.

4125 (DPST–87-341) **Average wind statistics for SRP area meteorological towers.** Laurinat, J.E. Du Pont de Nemours (E.I.) and Co., Aiken, SC (United States). Savannah River Lab. 29 Jun 1987. 82p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC09-89SR18035 ;AC09-76SR00001. Order Number DE93000592. Source: OSTI; NTIS; INIS; GPO Dep.

A quality assured set of average wind Statistics for the seven SRP area meteorological towers has been calculated for the five-year period 1982–1986 at the request of DOE/SR. A Similar set of statistics was previously compiled for the years 1975– 1979. The updated wind statistics will replace the old statistics as the meteorological input for calculating atmospheric radionuclide doses from stack releases, and will be used in the annual environmental report. This report details the methods used to average the wind statistics and to screen out bad measurements and presents wind roses generated by the averaged statistics.

4126 (ECN-RX–92-025) **CO_2 removal in competition with other options for reducing CO_2 emissions.** Okken, P.A.; Lako, P.; Gerbers, D.; Kram, T.; Ybema, J.R. Netherlands Energy Research Foundation (ECN), Petten (Netherlands). Jun 1992. 16p. (In Dutch). Order Number DE92557266. Source: OSTI; NTIS (US Sales Only).

Paper presented at the First International Conference on Carbon Dioxide Removal, Amsterdam (Netherlands), 4-6 March 1992.

CO_2 reduction scenarios are calculated with the MARKet ALlocation model (MARKAL) in a bottom-up analysis of the evolution of the Netherlands energy system for the period 2000-2040. In these calculations moderate fuel price increases, stringent environmental constraints, steady improvements in energy efficiency and major energy alternatives are taken into account. Preliminary results indicate a strong potential for CO_2 removal from fossil fuels in combination with electricity and hydrogen production, at severe CO_2 emission constraints. 5 figs., 3 tabs., 9 refs.

4127 (EGG–10617-1082) **An aerial radiological survey of the Brookhaven National Laboratory and surrounding area, Upton, New York: Date of survey: March 1990.** EG and G Energy Measurements, Inc., Las Vegas, NV (United States). Remote Sensing Lab. Sep 1992. 27p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC08-88NV10617. Order Number DE93003328. Source: OSTI; NTIS; INIS; GPO Dep.

An aerial radiological survey was performed from March 21 to March 24, 1990, over approximately a 65-square-kilometer (25-square-mile) area surrounding the Brookhaven National Laboratory (BNL) which is located at the center of Suffolk County, Long Island, New York. All gamma radiation data were collected flying

east-west lines spaced 76 meters (250 feet) apart at an altitude of 46 meters (150 feet) above ground level (AGL). Count rates obtained from the aerial platform were converted to exposure rates at 1 meter above the ground. The typical terrestrial-plus-cosmic background exposure rate in the survey area ranged from 5 to 10 microroentgens per hour (μR/h). The reported exposure rate values include an estimated cosmic ray contribution of 3.6 μR/h. Ground-based measurements made two weeks later were compared to the aerial survey results. Pressurized ion chamber readings, soil samples, and in situ high purity germanium measurements were taken from 54 locations within the survey area. Exposure rate values obtained from these measurements were in general agreement with those obtained from the aerial data. A total of 16 areas of man-made radioactivity were identified within the survey boundary. The dominant man-made radioisotopes found were cesium-137, sodium-22, manganese-54, cobalt-58, and cobalt-60. The BNL was previously surveyed in June 1983 and May 1980. The results of the present survey are in good agreement with the results of the previous surveys.

4128 (EGG–10617-1150) **HGSYSTEM: Dispersion models for ideal gases and hydrogen fluoride tutorial and quick reference guide.** Witlox, H.W.M. (Shell Research Ltd., Chester (United Kingdom). Thornton Research Centre). EG and G Energy Measurements, Inc., Las Vegas, NV (United States); Industry Cooperative Hydrogen Fluoride Mitigation/Assessment Program (United States). Ambient Impact Assessment Subcommittee; Shell Research Ltd., Chester (United Kingdom). Thornton Research Centre. May 1991. 232p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC08-88NV10617. Order Number DE93000952. Source: OSTI; NTIS (documentation only); ESTSC (complete software package), P.O. Box 1020, Oak Ridge, TN 37831-1020; GPO Dep.

The thermodynamic behavior of hydrogen fluoride when diluted with air, particularly moist air, is very different from that of a simple ideal gas. The gas-air mixture can, depending on conditions, be denser than ambient air or substantially less dense than air. This behavior of an HF cloud would have a major influence on the dispersion behavior of HF in the atmosphere if it were released accidentally. For gases such as LNG thermodynamic effects must be included in dispersion models in order to accurately simulate such releases. Because of the unique thermodynamic properties of HF, it was felt that those properties would be important in accurately simulating an HF release. This program identified three major areas in which substantial uncertainties existed in previous models: (1) the modeling of the complex thermodynamics of HF/H_2O/Air mixtures (including aerosol effects on cloud density); (2) the treatment of a wide range of surface roughness conditions (including possible multiple surface roughness conditions) and (3) jet flow and air entrainment for pressurized releases of HF, followed by transition to ground-based dense gas dispersion. Major objectives of this study were to develop and validate computer-based models to calculate the release properties in addition to simulating jet and plume behavior downwind of an accidental release of HF. This report serves as a guide to the installation and operation of the HGSYSTEM model.

4129 (EGG–10617-1152) **Development and validation of atmospheric dispersion models for ideal gases and hydrogen fluoride: Part 2, HGSYSTEM program user's manual.** Witlox, H.W.M.; McFarlane, K.; Rees, F.J.; Puttock, J.S. EG and G Energy Measurements, Inc., Las Vegas, NV (United States); Industry Cooperative Hydrogen Fluoride Mitigation/Assessment Program (United States). Ambient Impact Assessment Subcommittee; Shell Research Ltd., Chester (United Kingdom). Thornton Research Centre. Nov 1990. 538p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC08-88NV10617. Order Number DE93000954. Source: OSTI; NTIS (documentation only); ESTSC (complete software package), P.O. Box 1020, Oak Ridge, TN 37831-1020; GPO Dep.

The thermodynamic behavior of hydrogen fluoride when diluted with air, particularly moist air, is very different from that of a simple ideal gas. The gas-air mixture can, depending on conditions, be denser than ambient air or substantially less dense than air. This behavior of an HF cloud would have a major influence on the dispersion behavior of HF in the atmosphere if it were released accidentally. For gases such as LNG thermodynamic effects must be included in dispersion models in order to accurately simulate such releases. Because of the unique thermodynamic properties of HF, it was felt that those properties would be important in accurately simulating an HF release. This program identified three major areas in which substantial uncertainties existed in previous models: (1) the modeling of the complex thermodynamics of HF/H_2O/Air mixtures (including aerosol effects on cloud density); (2) the treatment of a wide range of surface roughness conditions (including possible multiple surface roughness conditions) and (3) jet flow and air entrainment for pressurized releases of HF, followed by transition to ground-based dense gas dispersion. Major objectives of this study were to develop and validate computer-based models to calculate the release properties in addition to simulating jet and plume behavior downwind of an accidental release of HF. This report is the HGSYSTEM Program User's Manual.

4130 (ETDE-mf–93728814) **Results of the ozone measurements carried out near to the ground in the first half year 1991.** Sonderbeobachtungen des Meteorologischen Observatoriums Hohenpeissenberg. Deutscher Wetterdienst, Hohenpeissenberg (Germany). Meteorologisches Observatorium. 1992 162p. (In German). Order Number DE93728814. Source: OSTI; NTIS (US Sales Only).

The report of the first half of 1991 contains tables and diagrams with the data of ozone measurements carried out near to the ground as well as the general ozone and sulphure dioxide measurements made by the Hohenpeissenberg station. The tables on ozone soundings also give the air pressure and temperature for any height of measurement. (orig.).

4131 (GKSS–92/E/12) **Turbulence modeling for flow with helicity.** Cieszelski, R. (GKSS, Inst. fuer Physik, Geesthacht (Germany)). GKSS-Forschungszentrum Geesthacht GmbH, Geesthacht-Tesperhude (Germany). 1992. 142p. (In German). Order Number DE93728907. Source: OSTI; NTIS (US Sales Only).

To improve the vortex conservation of grid point models applied in meteorology, energy and helicity conservation is taken into account for subgrid turbulence modelling. For the mean flow equations the 'Ansatz' of Lautenschlager, Eppel and Thacker (1988) is used, who takes into account the influence of turbulent kinetic energy and helicity. The subgrid scale model keeps the prognostic equation of turbulent kinetic energy (TKE) and in addition the equation of turbulent helicity; it is called TKEH-model. Two examples of simulation using TKEH-modelling show improved vortex conservation in comparison to diffuse TKE-modelling. On one hand the simulated decay of a barotropic tropical cyclone segment is slowed down. On the other hand, TKEH-modelling stabilizes the rotation of simulated thermals. (orig.) With 15 figs., 10 tabs.

4132 (INIS-mf–13376, pp. 57) **Central Laboratory for Radiological Protection in Warsaw about contamination level in Poland in March 1990: Statement.** National Atomic Energy Agency, Warsaw (Poland); Centralne Lab. Ochrony Radiologicznej, Warsaw (Poland). Apr 1990. 60p. (In Polish). In *Four years after nuclear power plant accident at Chernobyl.* Order Number DE93607099. Source: OSTI; NTIS (US Sales Only); INIS.

Short communication. CONTAMINATION/poland; POLAND/contamination; AIR; CESIUM 137; COMPARATIVE EVALUATIONS; CONTAMINATION; POLAND; DOSE RATES; MILK; RADIATION HAZARDS; STATISTICAL DATA

4133 (INIS-mf–13379) **Radon quantification in dwellings of different construction located in Pichincha Province.** Ayala, Maria Mercedes (Universidad Central de Ecuador, Facultad de Ciencias Fisicas y Matematicas, Escuela de Ingenieria Quimica Quito, (Ecuador)). Universidad Central del Ecuador, Quito (Ecuador). 1992 166p. (In Spanish). Order Number DE93607159. Source: OSTI; NTIS (US Sales Only); INIS.

The desintegration of uranium-238 yields radon-222 present in most dwellings and buildings. Radon-222 gets into them, accumulatively, through floors and walls, domestic fuel-gas and drinking water pipes. Upon inhalation radon is cancer's causes, death-rate being about 5000 deaths per year in USA. This fact evidences the

necessity to quantifying radon in dwellings in Ecuador. This research involves data from dwellings built up with different types of raw materials found spread in Pichincha province. The SSNTD method using a cellulose nitrate sensible film LR-115 was used for the research. The incidence of temperature, altitude, ventilation on the concentration gas Rn^{222} were also subject of a qualitative study. Eventually, the results shows that the adobe dwellings and/or poorly ventilated dwellings produce maximum concentration of Rn^{222}. Some cases show that ground floors have higher rate of Rn^{222} than the first or second floors, meaning that the gas is also coming up from the ground. in any case the level of Rn^{222} concentration is less than accepted limit 200 Bq/m^3 by UNCEAR only places, such as Mindo and Calderon, surpass the limit.

4134 (KFK-PEF–80-Vol.1, pp. 1-25) **Efficient strategies for air pollution control in Baden-Wuerttemberg.** Voss, A. (Stuttgart Univ. (Germany). Inst. fuer Energiewirtschaft und Rationelle Energieanwendung (IER)); Friedrich, R.; Obermeier, A. Kernforschungszentrum Karlsruhe GmbH (Germany). Projekt Europaeisches Forschungszentrum fuer Massnahmen zur Luftreinhaltung (PEF). Apr 1991. (In German). (CONF-9103265–Vol.1: 7. annual report of the Research Program for Air Pollution Prevention Measures of Kernforschungszentrum Karlsruhe GmbH, Karlsruhe (Germany), 5-7 Mar 1991). In *7th PEF status colloquium of March 5-7, 1991, Nuclear Research Center Karlsruhe.* 404p. Order Number DE93729025. Source: OSTI; NTIS (US Sales Only).

Damage to forests in Europe, increasing ozone-levels in the troposphere, ozone depletion in the stratosphere, respiratory deseases, acidification of lakes and other environmental damages are at least partly coused by air pollution. Reduction of emissions of pollutants as a means of environmental protection results in additional expenditure, which adds up to annual costs of several billions of DM/year. Maximum reduction of emission with least additional costs is therefore an important policy objective. In this contribution some research activities are summarized, their results giving an important support of political decision-makers with regard to the realization of efficient air pollution control strategies in Baden-Wuerttemberg. Further developments of methods and systems analysis required, as well as future tasks will be discussed additionally. (orig./UWA).

4135 (KFK-PEF–80-Vol.1, pp. 295-308) **Experiment with exclusion of gaseous pollutants on spruce trees at Edelmannshof. Pt. A. Chamber operation (results of investigation on climate and air chemistry).** Evers, F.H. (FVA Baden-Wuerttemberg, Freiburg im Breisgau (Germany)); Hoyer, V.; Schnepf, M.; Seufert, G. Kernforschungszentrum Karlsruhe GmbH (Germany). Projekt Europaeisches Forschungszentrum fuer Massnahmen zur Luftreinhaltung (PEF). Apr 1991. (In German). (CONF-9103265–Vol.1: 7. annual report of the Research Program for Air Pollution Prevention Measures of Kernforschungszentrum Karlsruhe GmbH, Karlsruhe (Germany), 5-7 Mar 1991). In *7th PEF status colloquium of March 5-7, 1991, Nuclear Research Center Karlsruhe.* 404p. Order Number DE93729025. Source: OSTI; NTIS (US Sales Only).

In winter 1989/90 SO_2-pollution at Edelmannshof was extremely low caused by mild climate with high temperature and few freeze. The level of ozone with 94,5 $\mu m/m^3$ in summer 1990 and monthly averages up to 128 $\mu m/m^3$ was raised in comparision to 1989. Since starting monitoring of air pollution at Edelmannshof in 1984 the level of ozone annually went up continuously and increased about 75%. The climate of 1989 and 1990 featured of mild winters and draught in summers caused water shortage for the the investigated spruces. The investigation on site conditions shows only slight differences between chambers and ambient on temperature or relative humidity. In the chambers the potential evaporation is reduced with regard to the ambient. Further investigations on chamber climate confirm the already presented results. Even on high immission concentrations the exclusion rate in chambers with charcoal filtered air was more than 75% in comparision with ambient air. (orig./UWA).

4136 (KFK-PEF–92) **Development of a decision support system for emission reduction and emission control technologies.** Hillenbrand, R. (Karlsruhe Univ. (T.H.) (Germany). Inst. fuer Industriebetriebslehre und Industrielle Produktion (IIP)); Hackenberg, D.; Rentz, O. Kernforschungszentrum Karlsruhe GmbH (Germany). Projekt Europaeisches Forschungszentrum fuer Massnahmen zur Luftreinhaltung (PEF). May 1992. 154p. (In German). Contract PEF 89/001/4162. Order Number DE93728957. Source: OSTI; NTIS (US Sales Only).

The Baden-Wuerttemberg Government Committee "Economic Development, Environment and Industrial Production" (Wirtschaftliche Entwicklung, Umwelt und Industrielle Produktion) has recommended that the development of the state-of-the-art in emission reduction should be documented and made accessible by a modern information system for control technologies. Within this project a decision support system for selection and evaluation of emission control technologies was developped, which was programmed on personal computer and integrated in the information system TEMITEC. This system helps potential users respectively operators of environmental technologies selecting adequate processes. Considering their specific combustion requirements emission control measures for dedusting, desulphurization and denitrification at stationary combustion units for steam production in the competence of the German TA Luft are selected. This project was carried out in cooperation with a group of test users and the work group "Flue Gas Cleaning Data Bank (DABARA)" under the overall control of the Ministry of Environment from the State Baden-Wuerttemberg. (orig.) With 21 figs., 3 tabs., 195 refs.

4137 (LA-UR–92-3030) **Using a second-order turbulence radiative-convective model to study the cloud/radiation interaction with the FIRE data.** Kao, C.Y.J. Los Alamos National Lab., NM (United States). [1992]. 5p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. (CONF-930142–1: 4. American Meteorological Society (AMS) symposium on global change studies, Anaheim, CA (United States), 14-19 Jan 1993). Order Number DE93000678. Source: OSTI; NTIS; INIS; GPO Dep.

It is well recognized that extended sheets of low-level stratus and stratocumulus clouds are a persistent feature over the eastern parts of the major ocean basins associated with the quasipermanent subtropical high-pressure systems. These clouds exert a strong influence on climate through their high albedo, compared with the underlying surface, and their low altitude. The former leads to a reduction of the net incoming shortwave flux into the atmosphere and the latter leads to an infrared loss in a way essentially the same as the cloud-free conditions. Randall et al.[1984] estimated that an increase of a few percent of global low-level stratiform clouds may offset the warming caused by a doubling of the atmos-pheric CO_2. The Atmospheric Radiation Measure-ment (ARM) Program, sponsored by the US Department of Energy, is envisioning a locale in the Eastern North Pacific for extensive measure-ments of stratiform boundary-layer clouds and their interaction with atmospheric radiation. Thus, a physically-based parameterization sheme for marine low-level stratiform clouds can be developed for general circulation models (GCMs). This paper is a modeling study with the current understanding of the important physical processes associated with a cloud-capped boundary layer. The numerical model is a high-resolution one-dimensional version of the second-order turbulence convective/radiative model developed at the Los Alamos National Laboratory.

4138 (LA-UR–92-3170) **Ambient air monitoring for organic compounds, acids, and metals at Los Alamos National Laboratory, January 1991.** Williams, C.H. (Radian Corp., Austin, TX (United States)); Eberhart, C.F. Los Alamos National Lab., NM (United States). [1992]. 139p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. Order Number DE93000860. Source: OSTI; NTIS; INIS; GPO Dep.

Los Alamos National Laboratory (LANL) contracted Radian Corporation (Radian) to conduct a short-term, intensive air monitoring program whose goal was to estimate the impact of chemical emissions from LANL on the ambient air environment. A comprehensive emission inventory had identified more than 600 potential air contaminants in LANL's emissions. A subset of specific target chemicals was selected for monitoring: 20 organic vapors, 6 metals and 5 inorganic acid vapors. These were measured at 5 ground level sampling sites around LANL over seven consecutive days in

January 1991. The sampling and analytical strategy used a combination of EPA and NIOSH methods modified for ambient air applications.

4139 (LBL–32665) **Carbon emissions and sequestration in forests: Case studies from seven developing countries: Volume 4: Mexico: Draft.** Makundi, W. (Lawrence Berkeley Lab., CA (United States)); Sathaye, J. (eds.); Cerutti, O.M.; Ordonez, M.J.; Minjarez, R.D. Lawrence Berkeley Lab., CA (United States); Environmental Protection Agency, Washington, DC (United States). Aug 1992. 55p. Sponsored by Environmental Protection Agency, Washington, DC (United States). DOE Contract AC03-76SF00098. Order Number DE93001599. Source: OSTI; NTIS; GPO Dep.

Estimates of carbon emissions from deforestation in Mexico are derived for the year 1985 and for two contrasting scenarios in 2025. Carbon emissions are calculated through an in-depth review of the existing information on forest cover deforestation mtes and area affected by forest fires as well as on forests' carbon-related biological characteristics. The analysis covers both tropical – evergreen and deciduous – and temperate – coniferous and broadleaf – closed forests. Emissions from the forest sector are also compared to those from energy and industry. Different policy options for promoting the sustainable management of forest resources in the country are discussed. The analysis indicates that approximately 804,000 hectares per year of closed forests suffered from major perturbations in the mid 1980's in Mexico, leading to an annual deforestation mte of 668,000 hectares. Seventy five percent of total deforestation is concentrated in tropical forests. The resulting annual carbon balance is estimated in 53.4 million tons per year, and the net committed emissions in 45.5 million tons or 41% and 38%, respectively, of the country's total for 1985–87. The annual carbon balance from the forest sector in 2025 is expected to decline to 16.5 million tons in the low emissions scenario and to 22.9 million tons in the high emissions scenario. Because of the large uncertainties in some of the primary sources of information, the stated figures should be taken as preliminary estimates.

4140 (PNL–8149) **Hanford Site environmental data for calendar year 1991: Surface and Columbia River.** Bisping, L.E.; Woodruff, R.K. Pacific Northwest Lab., Richland, WA (United States). Sep 1992. 440p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE93003339. Source: OSTI; NTIS; INIS; GPO Dep.

Environmental monitoring at the Hanford Site, located in southeastern Washington State, is conducted by Battelle Memorial Institute, Pacific Northwest Division, as part of its contract to operate the Pacific Northwest Laboratory (PNL) for the US Department of Energy. Pacific Northwest Laboratory publishes an annual environmental report for the Hanford Site each calendar year. This report is a summary of offsite and onsite environmental monitoring data collected during 1991 by PNL's Environmental Monitoring Program. The data summaries included in the annual report were created from individual surface and river monitoring results. This volume contains the individual results used to create those summaries. This volume also includes selected additional data summaries that do not appear in the annual report.

4141 (PNL-SA–20711) **Basin meteorology, with examples from the American Southwest (Grand Canyon region) in winter.** Whiteman, C.D.; Allwine, K.J. Pacific Northwest Lab., Richland, WA (United States). Sep 1992. 6p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. (CONF-9209173–3: 22. International conference on alpine meteorology, Toulouse (France), 7-11 Sep 1992). Order Number DE93001558. Source: OSTI; NTIS; GPO Dep.

In winter, deep temperature inversions build up over the floor (~1150 m MSL) of the Colorado Plateaus Basin to the level of the mountain barrier on the basin's western edge (2000–2400 m MSL). During daytime, a convective boundary layer (CBL) grows upward into the base of this inversion from the basin floor. Winter daytime values of sensible heat flux are too small to break the inversion, and the CBL typically grows to depths of only 400–600 m AGL. Nighttime downward sensible heat fluxes extract more heat from the atmosphere than is gained by the atmosphere during daytime, so that the basin inversion persists over long periods and is destroyed only by passing synoptic-scale disturbances. Basin winds are usually weak, and recirculations are frequent feature within the basin. Surface flows in the region are often counter to valley wind theory, due to unusual topography in which the prevailing terrain slope is counter to the direction of flow of the Colorado River.

4142 (PNL-SA–20898) **Wintertime meteorology of the Grand Canyon region.** Whiteman, C.D. Pacific Northwest Lab., Richland, WA (United States). Sep 1992. 8p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. (CONF-9209163–3: 6. American Meteorological Society conference on mountain meteorology, Portland, OR (United States), 29 Sep - 2 oct 1992). Order Number DE93001557. Source: OSTI; NTIS; GPO Dep.

The Grand Canyon region of the American Southwest is an interesting region meteorologically, but because of its isolated location, the lack of major population centers in the region, and the high cost of meteorological field experiments, it has historically received little observational attention. In recent years, however, attention has been directed to episodes of visibility degradation in many of the US National parks, and two recent field studies focused on this visibility problem have greatly increased the meteorological data available for the Grand Canyon region. The most recent and comprehensive of these studies is the Navajo Generating Station Winter Visibility Study of 1989–90. This study investigated the sources of visibility degradation in Grand Canyon National Park and the meteorological mechanisms leading to low visibility episodes. In this paper we present analyses of this rich data set to gain a better understanding of the key wintertime meteorological features of the Grand Canyon region.

4143 (PNL-SA–20899) **Single-station integral measures of atmospheric stagnation, ventilation, and recirculation.** Allwine, K.J.; Whiteman, C.D. Pacific Northwest Lab., Richland, WA (United States). Sep 1992. 6p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. (CONF-9209163–2: 6. American Meteorological Society conference on mountain meteorology, Portland, OR (United States), 29 Sep - 2 oct 1992). Order Number DE93001554. Source: OSTI; NTIS; GPO Dep.

In air pollution work, terms such as stagnation, ventilation, and recirculation have come to be used to indicate special types of flow conditions that produce important effects on the dispersion of air pollutants. Stagnations are events where atmospheric flows decrease in speed, or stop altogether, allowing pollutants to build up in stagnant air in the vicinity of the pollutant sources. Ventilations, on the other hand, are events in which a confined polluted air mass is driven away and replaced by fresh air. Finally, a recirculation is an event in which polluted air is initially carried away from the source region but later returns to produce a high pollution episode. The three terms, when used in air pollution work, are often used in a general sense, but rarely are defined mathematically to allow a numerical evaluation of the flow character. In the present work we develop mathematical definitions of these terms by focusing directly on the relevant atmospheric transport conditions, irrespective of pollution levels. The mathematical definitions of several single- station integral quantities representative of stagnation, ventilation, and recirculation are described, and the approach is applied to a wind data et from a radar profiler at Page, Arizona.

4144 (PNL-SA–21231) **Effects of mesoscale surface inhomogeneities on atmospheric boundary layer transfer.** Shaw, W.J.; Doran, J.C.; Hubbe, J.M. Pacific Northwest Lab., Richland, WA (United States). Sep 1992. 17p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830 ;W-31109-ENG-38 ;W-7405-ENG-36. (CONF-9209158–5: 10. symposium on turbulence and diffusion, Portland, OR (United States), 29 Sep - 2 oct 1992). Order Number DE93001515. Source: OSTI; NTIS; GPO Dep.

Defining the nature of turbulent transfer over horizontally inhomogeneous surfaces remains one of the challenges in meteorology. Because the transfer of energy and momentum through the atmospheric boundary layer forms part of the lower boundary condition for global climate models (GCMs), the problem is important. Over the last two decades, advances in sensor and computer technology wave made good point measurements of turbulent fluxes fairly routine. A fundamental question with respect to climate models,

however, is how such point measurements are related to average fluxes over the area of a GCM grid box. In this paper we will use data from the field program to depict the evolution of the boundary layer over adjacent, sharply contrasting surface types on two separate occasions. We will then use simple scaling based on the observations to argue that sub-gridscale motions would often be likely to significantly alter the estimates and resulting parameterizations of GCM-scale surface fluxes in the region.

4145 (PTB-Ra–30) **Radionuclide concentration in ground-level air in 1991 in North Germany.** Kolb, W.; Wershofen, H. Physikalisch-Technische Bundesanstalt, Braunschweig (Germany). Radioaktivitaet. Mar 1992. 22p. Order Number DE93728836. Source: OSTI; NTIS (US Sales Only); INIS.

The activity concentration of various fission products and some other radionuclides (e.g. Be-7, Na-22, K-40 and Pb-210) contained in ground-level air were determined by gamma-ray spectroscopy. Weekly and mean monthly activity concentrations measured in Brunswick and Berlin are tabulated. From 1990 to 1991 the Cs-137 concentration in Brunswick decreased only slightly. It was less than 0.1% of that in 1986 but due to resuspended soil dust still three times higher than in 1985. Occasionally, traces of activation products were detected such as Cr-51, Mn-54 or Co-60 in Januray and February in Brunswick and Berlin. The effective equivalent dose due to the inhalation of fission products is estimated to be less than 0.1% of the Pb-210 inhalation dose. (orig.).

4146 (UCRL-ID–112135) **An investigation of the dependence of atmospheric radiative transfer on aerosol size distribution.** Molenkamp, C.R. Lawrence Livermore National Lab., CA (United States). Oct 1992. 43p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. Order Number DE93003333. Source: OSTI; NTIS; GPO Dep.

The effect of aerosol particle size distribution on the transfer of solar and infrared radiation in the Atmosphere is investigated by calculating radiances using LOWTRAN 7. We show that measurable changes occur in downward direct and scattered solar radiance for a background rural aerosol as the mode radius and standard deviation are changed. Aerosols with particles primarily larger than 0.5 μm have fairly uniform effects at visible wavelengths, while aerosols with particles mainly smaller than 0.1 μm scatter more sunlight as the wavelength becomes shorter. The largest sensitivity to changes in particle size occur in the downward scattered solar, indicating that this parameter would be most likely to provide an indication of aerosol size distribution and optical properties. Upward scattered sunlight is increased only slightly by background amounts of boundary layer aerosol. Increased absorption by aerosol particles had only a small effect on the downward direct solar radiance, but produced a large relative change in downward scattered solar radiance. The presence of background amounts of boundary layer aerosol had no measurable effect on infrared fluxes.

4147 (UCRL-JC–111848) **Effects of the Mt. Pinatubo eruption on the chemistry, radiative, and transport processes in the stratosphere.** Wuebbles, D.J.; Kinnison, D.E.; Grant, K.E.; Connell, P.S. Lawrence Livermore National Lab., CA (United States). Sep 1992. 10p. Sponsored by USDOE, Washington, DC (United States); National Aeronautics and Space Administration, Washington, DC (United States). DOE Contract W-7405-ENG-48. (CONF-930133–3: 73. American Meteorological Society (AMS) annual meeting, Anaheim, CA (United States), 17-22 Jan 1993). Order Number DE93001508. Source: OSTI; NTIS; INIS; GPO Dep.

Volcanic eruptions can significantly impact trace gas distribution in the upper troposphere and lower stratosphere. Massive eruptions, produce large quantities of SO_2, H_2O, chlorine compounds, and particulates. Modeling the effects of these impulsive increases in traces gases and comparing the results with observations from ground and satellite measurements provide unique opportunities to test current multi-dimensional chemical-radiative-transport models of the global atmosphere. Since these models are currently being used in assessment studies for future anthropogenic emissions of trace gases quantitative understanding of the accuracy of these models is essential. In this study, we have used observed data from the Stratospheric Aerosol and Gas Experiment II (SAGE II) aboard the Earth Radiation Budget Satellite (ERBS) to realistically represent both the time dependent change in aerosol surface area density and wavelength dependent extinction values from the Mt. Pinatubo Eruption. Increases in the aerosol loading increase the rate of important heterogeneous chemical reactions converting odd nitrogen in both $ClONO^2$ and N_2O_5 to HNO_3. Radiative effects of increases aerosol optical thickness include changes to net radiative heating rates and to actinic fluxes. Changes to heating rates will indirectly change chemical reaction rates via changes in atmospheric temperatures. changes in actinic fluxes will directly modify photodissociation rates.

4148 (WSRC-TR–92-136) **Heavy rainfall at the SRS in July, August and October of 1990.** Addis, R.P.; Kurzeja, R.J. Westinghouse Savannah River Co., Aiken, SC (United States). [1992]. 33p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC09-89SR18035. Order Number DE93002156. Source: OSTI; NTIS; GPO Dep.

The Savannah River Site experienced intense periods of rainfall on July 25, August 22, October 10–12, and October 22–23, 1990. This report compares the rainfall from these storms with previous storms and with the 100 year rainfall estimates.

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Refer also to citation(s) 2570, 2602, 2616, 2618, 2619, 2620, 2631, 2660, 2661, 2662, 2663, 2664, 2668, 2670, 2730, 2732, 2743, 2746, 2750, 2766, 2767, 2769, 2779, 2813, 2819, 2822, 2823, 2824, 2825, 2826, 2827, 2829, 2830, 2831, 2832, 2833, 2834, 2835, 2836, 2837, 2838, 2839, 2846, 2906, 3028, 3084, 3085, 3086, 3087, 3464, 3466, 3470, 3535, 3536, 3537, 3538, 3539, 3549, 3556, 3725, 3796, 4020, 4110, 4112, 4127, 4133, 4139, 4140, 4228, 4229, 4230, 4231, 4233, 4238, 4254, 4361, 4366, 4372, 4785

4149 (AECS-G/RSS–35) **The use of radon gas techniques in water and soil for monitoring the tectonics and fault activities in Syria 1991.** Al-Hilal, Mohamed (Atomic Energy Commission, Damascus (Syrian Arab Republic)); Al-Hent, Rashad; Kataa, Bassam. Atomic Energy Commission, Damascus (Syrian Arab Republic). Mar 1992. 53p. (In Arabic). Order Number DE93607102. Source: OSTI; NTIS (US Sales Only); INIS.

Radon, Rn^{222}, is continuously emanated from the earth crust as an intermediate decay product of U^{238} radioactive series. The amount of radon that generated from the crustal rocks into atmosphere is normally very small. However, radon emission is known to be anomalously large on active faults and possibly nearby seismic activities. This report presents the possibility of using radon technique for monitoring tectonics and localizing geological faults in Syria. A network of ten sampling stations were set up along the north-south trend Al-Ghab transform fault, which lies within the most active seismic zone in the country. In addition, five stations were set up in parallel to the Palmyride fold belt which extends in SW-NE direction along the central part of Syria. Monthly radon variations were measured in both groundwater and soil gases. Radon data that obtained from this study reveals that the method of radon monitoring over faults seems to be quite useful and successful in identifying geological faults. A correlation between seismic activities, in the region, and radon data has been investigated, and the result shows a fairly good association between radon variations and earthquakes of magnitude (Md > 3). (author). 8 refs., 13 figs., 24 tabs.

4150 (AECS-PR/FRSR–58) **The diffusion of some radionuclides in local rocks collected from potential repository in Syria.** Othman, Ibrahim (Atomic Energy Commission, Damascus (Syrian Arab Republic)); Abou Jamous, Jamal. Atomic Energy Commission, Damascus (Syrian Arab Republic). Jul 1992. 20p. (In Arabic). Order Number DE93607103. Source: OSTI; NTIS (US Sales Only); INIS.

Diffusion factor was estimated for ^{137} Cs in local rocks marl, limestone, and basalt. Slab activity measuring was constructed. Factors affecting the ^{137} Cs diffusion has been studied. These are dynamic state of water, length of contacting time and the concentration of radioisotope. (author). 9 refs., 12 figs., 6 tabs.

4151 (ANL/ESD/TM–32) **Development of an ultrasonic process for detoxifying groundwater and soil: Laboratory research: Annual report for fiscal year 1991.** Wu, J.M.; Huang, H.S.; Livengood, C.D. Argonne National Lab., IL (United States). Energy Systems Div. Jan 1992. 33p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-31109-ENG-38. Order Number DE93002117. Source: OSTI; NTIS; GPO Dep.

Argonne National Laboratory is conducting laboratory research to study the effectiveness of a new technique in which ultrasonic energy is used to convert chlorinated organic compounds into nonhazardous end products. Destruction efficiencies of greater than 99% were achieved for the organic compounds in aqueous solution. Key process parameters, such as solution pH values, steady-state temperatures under operating conditions, ultrasonic-power intensities, and oxidant concentrations, were investigated. In addition, a detailed chemical-kinetic mechanism for the destruction of the organic compounds under an ultrasonic filed was developed and incorporated into a computational model. The agreement between the model and experimental results is generally good.

4152 (CONF-910550–, pp. 753-765) **Environmental influences on diethyl phthalate biodegradation kinetics.** Reardon, K.F. (Colorado State Univ., Fort Collins (United States)); Zhang, G. National Renewable Energy Lab., Golden, CO (United States); Oak Ridge National Lab., TN (United States). 1992. From 13. symposium on biotechnology for fuels and chemicals; Colorado Springs, CO (United States); 6-10 May 1991. In *Thirteenth symposium on biotechnology for fuels and chemicals: Proceedings.* 846p. Source: The Humana Press, Inc., Totowa, NJ 07511 (United States).

The effects of temperature, dissolved oxygen level, and diethyl phthalate (DEP) concentration on the rates of DEP biodegradation have been investigated in shake flask and fermenter experiments, using aerobic and facultatively aerobic microorganisms. The aerobic strain followed Monod growth kinetics, and was negatively affected by temperatures lower than 25C and dissolved oxygen levels lower than 0.8 mg/L, whereas the specific DEP-degrading activity of the facultative strain was substrate inhibited under anaerobic conditions, higher at 150C than 25C under aerobic conditions, and unaffected by the dissolved oxygen level. Studies were also carried out in soil columns to identify additional factors that might be important for modeling DEP biodegradation.

4153 (CONF-9109358–, pp. 19) **Application of leaching algorithms and worst-case analysis to assessment of risk to ground water from contaminated soils.** Bradford, W.L.; Flanzenbaum, J. USDOE, Washington, DC (United States). [1991]. From 8. international conference on chemistry for protection of the environment; Lublin (Poland); 16-18 Sep 1991. In *Chemistry for protection of the environment, Eight international conference: Proceedings.* 635p. Order Number DE92014317. Source: OSTI; NTIS; INIS.

Accurate determination of metal and organic compound concentrations in soils left in place sufficient to prevent ground-water contamination poses uncertainties arising from the complex mechanisms of contaminant leaching through the vadose zone. However, application of simple algorithms to roughly and conservatively simulate leaching through the vadose zone and dispersion in ground water, coupled with conservation worst-case assumptions, can often either demonstrate that soils left in place pose insignificant risk to ground water, or provide conservative estimates of target soil decontamination levels sufficient to protect the potential future users of ground water. In the example discussed in this paper, the authors evaluated the potential for ground-water contamination beneath a 1-acre (0.40 ha) area of soils left in place using: (1) the Organic Leaching Model, an algorithm based upon laboratory measurements relating organic concentrations in soil leachate to solubility to predict organic concentrations of organics in leachates; and (2) the maximum potential metals concentrations obtainable in a standard Toxicity Characteristic Leaching Procedure (TCLP), a test designed to simulate leaching of metals from landfill soils, to predict the concentrations of both organics and metals in leachates potentially entering ground water. Consistent with the worst-case analysis approach, the authors assumed that the entire vadose zone soil column contained contaminant concentrations at the highest levels measured in soil samples. The concentrations of specific contaminants predicted in soil leachates were compared with risk-based standards determined by U.S. EPA. Generally it was found that, in the worst case, the predicted concentrations in leachates themselves were well below the standards.

4154 (CONF-9109358–, pp. 19) **Determination of atrazine in Czechoslovakian water by competitive polyclonal enzyme immunoassay.** Bushway, R.J. (University of Maine, Orono (United States)); Hurst, H.L.; Perkins, L.B.; Skoczenski, B.A.; Harrison, R.O.; Fan, T.; Ferguson, B.S.; Fukal, L. USDOE, Washington, DC (United States). [1991]. From 8. international conference on chemistry for protection of the environment; Lublin (Poland); 16-18 Sep 1991. In *Chemistry for protection of the environment, Eight international conference: Proceedings.* 635p. Order Number DE92014317. Source: OSTI; NTIS; INIS.

Atrazine was analyzed by enzyme immunoassay (EIA) in 56 water samples from numerous locations and water supplies (drinking, laboratory, creek and river water) in Czechoslovakia. Two types of immunoassay technology were employed – tubes and microtiter plates. Tubes offer a rapid response under field conditions while with plates one has the advantage of being able to analyze 96 samples simultaneously. All 56 water samples were shown to be positive for atrazine by tube immunoassay with concentrations varying from 0.04 to 12,700 ng/ml with most below 0.3 ng/ml. Reproducibility of atrazine standard curves from day to day yielded percent coefficients of variation (% CVs) for the immunoassay of 5.7 to 10.9% while the repeatability for 20 field samples run on 6 different days had % CVs ranging from 2.1 to 29.4 with most below 15%. Agreement between 34 samples analyzed by both types of immunoassay was good with a Spearman coefficient of 0.847. Seventeen water samples were also analyzed by high-performance liquid chromatography and tube immunoassay. The agreement was excellent with a correlation coefficient of 0.998.

4155 (CONF-9109358–, pp. 15) **Technology screening for stabilization/solidification of contaminated soils.** Colonna, R. (The Earth Technology Corporation, Alexandria, VA (United States)); Pryately, C.; Mazey, R. USDOE, Washington, DC (United States). [1991]. From 8. international conference on chemistry for protection of the environment; Lublin (Poland); 16-18 Sep 1991. In *Chemistry for protection of the environment, Eight international conference: Proceedings.* 635p. Order Number DE92014317. Source: OSTI; NTIS; INIS.

Technology screening is a tool used to organize relevant information for each hazardous waste site for the purpose of evaluating the applicability of soil stabilization/solidification techniques. Such screening is required because of the imprecise nature of stabilization/solidification and because most wastes are far from homogeneous. This paper outlines a series of steps for screening technologies to determine their suitability for stabilization/solidification. An understanding of the site and its waste, bench-test evaluation of the stabilization/solidification waste from, and an understanding of the implementation and costs of stabilization/solidification will aid in making an informed judgment about technology suitability. The choice of a final technology will inevitably reflect a compromise based on chemical, physical, and cost considerations. This section does not discuss design considerations in the screening of stabilization/solidification technologies; rather, it discusses the feasibility of the technologies.

4156 (CONF-9109358–, pp. 22) **Simulation of contaminant transport in the unsaturated zone.** Uchrin, C.G. (Rutgers, The State University of New Jersey, New Brunswick (United States)); Williams, B.C. USDOE, Washington, DC (United States). [1991]. From 8. international conference on chemistry for protection of the environment; Lublin (Poland); 16-18 Sep 1991. In *Chemistry for protection of the environment, Eight international conference: Proceedings.* 635p. Order Number DE92014317. Source: OSTI; NTIS; INIS.

The fate and transport of volatile organic contaminants (VOC's) in soil/ground water systems has become an issue of national and local concern. A state-wide study of toxic contamination in New Jersey found that VOC's present the most serious threat to ground water contamination (Tucker, 1981). Toluene, a constituent of petroleum products is one VOC of concern. The number of gasoline storage tanks in the U.S. has been estimated to be between

1.5 and 2 million. Failure of these underground storage tanks, (UST's), is a major source of ground water pollution. It has been approximated that as many as 75,000 to 100,000 of these tanks leak (Predpall, et al. 1984). Buried gasoline tanks and service stations are the most common source of leakage investigated (Canter et al., 1987 pp.81). The Coastal Plains of New Jersey, which house predominantly sandy unconfined aquifers, are especially vulnerable to contamination. Pump and treat methods, while able to mobilize a significant mass of contaminants, invariably leaves a residual fraction the can contaminate the reserve for years to come. This residual fraction is composed of lighter organic compounds such as toluene, that due to its decreased density, 'float' on the ground water table in the capillary zone. A clear understanding of these lighter components and their mobility in the vadose and saturated zone is paramount in both the prediction of contaminant movement, and the clean-up/restoration of contaminated systems. This paper describes to date results form an ongoing study focusing on the mobility of toluene in the vadose zone.

4157 (CONF-9109358–, pp. 29) **Chemical sensors and field screening technologies in surface- and ground-water monitoring.** Poziomek, E.J. (University of Nevada, Las Vegas (United States)); Engelmann, W.H.; Koglin, E.N. USDOE, Washington, DC (United States). [1991]. From 8. international conference on chemistry for protection of the environment; Lublin (Poland); 16-18 Sep 1991. In *Chemistry for protection of the environment, Eight international conference: Proceedings.* 635p. Order Number DE92014317. Source: OSTI; NTIS; INIS.

Ideally, field screening methods for hazardous waste site investigations involve using of rapid, low-cost test methods to determine the presence or absence of analytes of interest, and can yield analyte concentrations within a predetermined range or threshold at a site. These methods help to quickly establish a directed comprehensive monitoring program for a given site, and assist in the assigning priority relative to other sites. Some methods may be as accurate and precise as laboratory methods. This paper presents the state-of-the-art in field screening technology with emphasis on emerging trends in surface- and ground-water monitoring. It includes an analysis of the output from the Second International Symposium on Field Screening Methods for Hazardous Wastes and Toxic Chemicals held in February 1991. Special consideration is given to chemical sensors that show promise toward miniaturization and low cost. The most mature technologies use gas chromatography (GC), mass spectrometry (MS), and x-ray fluorescence (XRF) spectrometry. Several emerging technologies are identified that show promise in the long term for surface- and ground-water monitoring. These include immunoassay field methods, ultraviolet and luminescence spectroscopy, ion mobility spectrometry (IMS), and spectroelectrochemistry.

4158 (CONF-9109358–, pp. 17) **Toxicological implications of remediating hazardous wastes.** Peterson, S.A. (U.S. EPA Environmental Research Laboratory, Corvallis, OR (United States)); Barich, J.J. III; Greene, J.C. USDOE, Washington, DC (United States). [1991]. From 8. international conference on chemistry for protection of the environment; Lublin (Poland); 16-18 Sep 1991. In *Chemistry for protection of the environment, Eight international conference: Proceedings.* 635p. Order Number DE92014317. Source: OSTI; NTIS; INIS.

Section 121 of the amendments (1986) to the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (SUPERFUND) calls for hazardous waste site remediations that will permanently and significantly reduce the volume, toxicity, or mobility of hazardous substances, pollutants, and contaminants. Traditional engineering technology has concentrated on reduction in volume and mobility as assessed by chemical and geophysical measures, assuming that reduction in volume and mobility would lead to reductions in toxicologically has hampered integrated assessments. Therefore, new work was initiated to assemble a battery of aquatic and terrestrial bioassays to be evaluated comparatively against several individual chemicals, mixtures of chemicals, and actual waste site chemical mixtures. The bioassays were then applied to a mobility reduction demonstration to help assess its overall chemical, physical, and biological performance. Results indicated that although remediation accomplished the primary objective of mobility reduction, it introduced undesirable secondary effects (toxicity). These trade-offs must be considered in the holistic sense with regard to the implementation and evaluation of remediation measures.

4159 (CONF-9109358–, pp. 7) **Forms of lead and cadmium soil in the vicinity of lead reprocessing smelter.** Brabec, E. (Botanical Institute (Czechoslovakia)); Mejstrik, V.; Velicka, J. USDOE, Washington, DC (United States). [1991]. From 8. international conference on chemistry for protection of the environment; Lublin (Poland); 16-18 Sep 1991. In *Chemistry for protection of the environment, Eight international conference: Proceedings.* 635p. Order Number DE92014317. Source: OSTI; NTIS; INIS.

The separation efficiency of two extraction methods was evaluated in percentage terms with respect to the results obtained by mineralization (reference); this efficiency was found to be higher for the deeper soil horizons than for horizons near the surface indicating that in deeper horizons, Pb and Cd are tied to the soil by weaker bonds. The extraction recovery did not improve significantly if the extraction time was extended from 1 hr to 3 hrs.

4160 (CONF-9109358–, pp. 20) **A field guide for characterization of hazardous waste sites.** Cameron, R.E. (Lockheed Engineering and Sciences Company, Las Vegas, NV (United States)). USDOE, Washington, DC (United States). [1991]. From 8. international conference on chemistry for protection of the environment; Lublin (Poland); 16-18 Sep 1991. In *Chemistry for protection of the environment, Eight international conference: Proceedings.* 635p. Order Number DE92014317. Source: OSTI; NTIS; INIS.

A field guide (knowledge book) has been developed to identify, describe, and interpret site and soil characteristics of hazardous waste sites. It particularly addresses U.S. Environmental Protection Agency (EPA) needs for standard procedures, guidelines, or protocols that stress site and soil contamination. Thirty-five 'knowledge frames' are provided for the most commonly encountered site and soil characteristics, each of which contains specific guidance for description of a parameter. The format of the knowledge frames is compatible with the Environmental Sampling Expert System (ESES) software. The field guide is also designed for use with an accompanying field pocket guide, which provides methods for site and soil description and analysis.

4161 (CONF-9109358–, pp. 10) **Ground water contamination with inorganic nitrogen in the vicinity of a solid waste landfill.** Rattue, K.G. (America North Inc., Anchorage, AK (United States)); Marinas, B.; Chapin, D. USDOE, Washington, DC (United States). [1991]. From 8. international conference on chemistry for protection of the environment; Lublin (Poland); 16-18 Sep 1991. In *Chemistry for protection of the environment, Eight international conference: Proceedings.* 635p. Order Number DE92014317. Source: OSTI; NTIS; INIS.

Subsurface investigations performed at the Hidden Valley Landfill since 1985 have provided information which indicates that landfilling operations have resulted in the release of leachate-derived contaminates into the uppermost water bearing zone beneath the landfill and the contamination of this aquifer hydraulically downgradient of the site. Sporadic detections of nitrate-nitrogen at concentrations greater than the federal primary drinking water standard of 10 milligrams per liter (mg/L) resulted in the implementation of a more intensive site-specific monitoring program, and consideration of alternatives to remediate affected ground water used for potable supply.

4162 (CONF-9109358–, pp. 17) **Removal of hazardous materials: Decontamination of soils and ground water at a hazardous waste disposal site.** Erdogan, H. (New Jersey Department of Environmental Protection, Trenton (United States)); Halasi-Kun, G.J. USDOE, Washington, DC (United States). [1991]. From 8. international conference on chemistry for protection of the environment; Lublin (Poland); 16-18 Sep 1991. In *Chemistry for protection of the environment, Eight international conference: Proceedings.* 635p. Order Number DE92014317. Source: OSTI; NTIS; INIS.

Improper and indiscriminate hazardous waste disposal resulted in several contaminated sites in the United States. The U.S. has over 32,000 potential sites throughout the country. There are 1,200

identified National Priority sites across the U.S. with most states having 10 or more sites. The state of New Jersey has the most number of superfund sites in the U.S. In this paper, potential soil and ground water decontamination methods including factors affecting performance of each method and application of the methods are analyzed. Additionally, cleanup of a superfund site in New Jersey including geology, hydrogeology of the site, extent of ground water contamination and soil and sediment contamination and proposed final remedial action are examined.

4163 (CONF-9109358–, pp. 8) **Heavy elements in fruit and vegetables cultivated in Siedlce district in Poland.** Zalewski, W. (Agricultural and Teachers University, Siedlce (Poland)); Oprzadek, K.; Syrocka, K.; Lipinska, J.; Jaroszynska, J. USDOE, Washington, DC (United States). [1991]. From 8. international conference on chemistry for protection of the environment; Lublin (Poland); 16-18 Sep 1991. In *Chemistry for protection of the environment, Eight international conference: Proceedings.* 635p. Order Number DE92014317. Source: OSTI; NTIS; INIS.

In the years 1988 and 1990 the content of iron, manganese, zinc, copper, nickel, lead and cadmium were determined by atomic absorption spectrometry methods in vegetables and fruits cultivated in Siedlce District. The metals concentration was measured in strawberry, black currant, red currant, apple, plum, carrot, cabbage, tomato, cucumber, red beet, parsley and celery (leaves and roots) and potato. Only in a few samples of parsley leaves and celery did the contents of lead and zinc exceed the limit permitted by Polish Ministry of Health. The contents of cadmium greater than 0.03mg/kg in fresh vegetable weight was found in many samples of parsley, celery and in several samples of carrot, potato, red beet and strawberry.

4164 (CONF-9109358–, pp. 8) **Relationship between livestock activities and nitrogen compounds in the aquifers of the Asturias and Cantabria provinces (Spain).** Navarrete, P. (Instituto Tecnologico GeoMinero de Espana (Spain)); Arenas, M.; Martin, G.; Virgos, L. USDOE, Washington, DC (United States). [1991]. From 8. international conference on chemistry for protection of the environment; Lublin (Poland); 16-18 Sep 1991. In *Chemistry for protection of the environment, Eight international conference: Proceedings.* 635p. Order Number DE92014317. Source: OSTI; NTIS; INIS.

This report presents the results of the analysis of nitrogen compounds (nitrate, nitrite and ammonia) on groundprovinces located in northern Spain. An evaluation of the contaminant load generated by breeding wastes, in terms of nitrogen contents, has been carried out. Samples were collected in springs and wells using the in-place pumps. Physical properties and nitrogen compounds were 'in situ' determined. The results of the analysis indicate low concentrations of nitrate and nitrite ions, but in some cases significant concentrations of ammonia, which origin is attributed to the farmer's wastes spilled in the neighborhood of the springs over high vulnerable aquifers with a low soil protection. Nitrate concentration agrees with the calculated nitrogen loads generated by livestock wastes.

4165 (CONF-9109358–, pp. 10) **Experimental approach to monitoring the presence and movement of pesticides in unsaturated zone and groundwater.** Navarrete, P. (Instituto Tecnologico GeoMinero de Espana (Spain)); Jimenez, J.R.; Aroca, E.; Beltran, J.; Esteller, M.V.; Hernandez, F.; Morell, I. USDOE, Washington, DC (United States). [1991]. From 8. international conference on chemistry for protection of the environment; Lublin (Poland); 16-18 Sep 1991. In *Chemistry for protection of the environment, Eight international conference: Proceedings.* 635p. Order Number DE92014317. Source: OSTI; NTIS; INIS.

An experimental work to determine the presence and movement of pesticides and related compounds in soil solution and groundwater is made in a citric crop field in the Plana of Castellon (Spain). A hydrogeological study of the whole aquifer has been carried out, to determine the hydrodynamic parameters affecting the behavior of the pollutants in the unsaturated and saturated zones, with emphasis in the lithological distributions, both vertical and horizontal, in the experimental field. The whole study includes the analysis of several water samples from the unsaturated zone at different depths, between 0.2 and 3.4 meters, and groundwater samples from two wells close to the experimental field. Moreover, several samples of soil were also collected and analyzed for their characterization. The procedure to collect soil solution samples was carried out by using pressure-vacuum soil samplers, consisting in PVC or stainless steel probes with porous ceramic cups. The vacuum within the sampler causes the moisture to move from the unsaturated zone through the cup. Several pesticides widely used in the area, at their recommended doses, were spread in the field and irrigation was made at the habitual rates for citric crops. Pesticides studied included organophosphorus and organochlorine insecticides, and phenoxyacid herbicides. Samples were collected monthly and given to the laboratory to analyze.

4166 (CONF-9109358–, pp. 1) **Tracing bomb-spike tritium to estimate rates of vertical recharge and pollutant transport through unsaturated glacial till.** Daniels, D.P. (Engineering Science, Atlanta, GA (United States)); Fritz, S.J.; Leap, D.I. USDOE, Washington, DC (United States). [1991]. From 8. international conference on chemistry for protection of the environment; Lublin (Poland); 16-18 Sep 1991. In *Chemistry for protection of the environment, Eight international conference: Proceedings.* 635p. Order Number DE92014317. Source: OSTI; NTIS; INIS.

Tracing the movement of ground water from recharge to discharge points is important in estimating both ground-water budgets and potential rates of vertical infiltration of pollutants from the surface. Particularly difficult is the task of estimating these rates in unsaturated geological materials. Atmospheric tritium, produced by above-ground nuclear-weapons testing in the late 1950's and early 60's, has been proven to be a very useful tracer in saturated materials. Recently, the authors used it to estimate vertical recharge rates in unsaturated glacial till. The results of their investigations, corroborated by an independent method, indicate that this tracer and methods of tracking it can be used to great advantage in estimating rates of vertical pollutant transport in unsaturated materials as well.

4167 (CONF-9109358–, pp. 13) **Toward a better understanding of the geographic distribution of radon in domestic water supplies.** Cech, I. (University of Texas School of Public Health, Houston (United States)); Siegele, P.; Merritt, M.; Venso, E. USDOE, Washington, DC (United States). [1991]. From 8. international conference on chemistry for protection of the environment; Lublin (Poland); 16-18 Sep 1991. In *Chemistry for protection of the environment, Eight international conference: Proceedings.* 635p. Order Number DE92014317. Source: OSTI; NTIS; INIS.

The ingestion and inhalation of radioactive products of uranium (U-238) decay, isotopes of radium (Ra-226) and radon (Rn-222), are worldwide concerns. Beginning in 1984, a series of sequential studies was carried out by Cech and coworkers at the University of Texas School of Public Health in the search for predictors of radium and radon presence in water supplies. Several hundred samples of water were collected from public and individually-owned domestic water sources, as well as from sources of water used for livestock watering, industrial purposes, and oil production. Data are mapped and statistically analyzed by aquifer, pumping depth, and distance from potential controlling features, such as faults, salt domes, lignite, and hydrocarbon deposits. This produced one of the largest databases ever collected on radionuclides in ground and surface water sources. Finding radon anomalies in Tertiary clastic aquifers in Texas suggests that unsuspected high concentrations may exist elsewhere in the world. While locations of deeply buried uranium bodies are difficult to predict, this study documents that high concentrations of radon are likely to be found in water pumped near zones of faulting and other potential uranium trapping features. This is important, as it offers the possibility of avoiding high risk areas when developing water wells.

4168 (CONF-9109358–, pp. 1) **Radium and radon in groundwater: Health significance and water well development strategies.** Cech, I. (The University of Texas Health Science Center, Houston (United States)). USDOE, Washington, DC (United States). [1991]. From 8. international conference on chemistry for protection of the environment; Lublin (Poland); 16-18 Sep 1991. In *Chemistry for protection of the environment, Eight international conference: Proceedings.* 635p. Order Number DE92014317. Source: OSTI; NTIS; INIS.

A series of studies was conducted in Texas to assess concentrations of Ra-226 and Rn-222 in ground and surface water supplies. Nearly 1,000 samples of drinking water were obtained from public and individually-owned domestic water wells and surface sources. In addition, samples are obtained from wells used for livestock watering, industrial purposes, and oil production. Concentrations as high as 23 pCi/l of Ra and 26,000 pCi/l of Rn were encountered in public water wells along the gulf coast and in parts of west-central Texas. These anomalously high concentrations are the result of the decay of naturally occurring uranium deposits in rocks below the aquifers. The same regions have been reported in the literature as being in the highest decile for the State of Texas and in the nation for respiratory cancer mortality. A similar position of aquifers above uranium-bearing sediments occurs in other parts of the world. While the location of deeply buried uranium bodies is difficult to predict, the Texas study documents that anomalously high concentrations of uranium progenies, Ra and Rn, are likely to be found in the ground water near zones of faulting. This is important, as it offers the possibility of avoiding high risk areas when developing water wells.

4169 (CONF-9109358–, pp. 16) **The design of soil restoration treatability studies.** Barich III, J.J. (USEPA, Seattle, WA (United States)); Barth, E.F.; Jones, R.R. USDOE, Washington, DC (United States). [1991]. From 8. international conference on chemistry for protection of the environment; Lublin (Poland); 16-18 Sep 1991. In *Chemistry for protection of the environment, Eight international conference: Proceedings.* 635p. Order Number DE92014317. Source: OSTI; NTIS; INIS.

Contaminated soils are a feature common to many hazardous waste sites in the United States. They are studied frequently to determine the nature and extent of contamination (site characterization), and less frequently to develop soil restoration strategies (treatability). Sampling and analytical needs for contaminated soil treatability studies are discussed, with emphasis on how treatability studies differ from the more common site characterization studies. The use of bulk site reference materials in the conduct of treatability studies is introduced.

4170 (CONF-9204205–1) **Cokriging surface elevation and seismic refraction data for bedrock topography.** Nyquist, J.E. (Oak Ridge National Lab., TN (United States)); Doll, W.E.; Davis, R.K.; Hopkins, R.A. Oak Ridge National Lab., TN (United States). [1992]. 14p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. From Symposium on application of geophysics to engineering and environmental problems; Oakbrook, IL (United States); 26-29 Apr 1992. Order Number DE93001369. Source: OSTI; NTIS; INIS; GPO Dep.

Analysis of seismic refraction data collected at a proposed site of the Advanced Neutron Source (ANS) Facility showed a strong correlation between surface and bedrock topography. By combining seismically determined bedrock elevation data with surface elevation data using cokriging, we were able to significantly improve our map of bedrock topography without collecting additional seismic data.

4171 (CONF-9204205–2) **Geophysical investigation and characterization with USRADS.** Flynn, C.R. (Chemrad Tennessee Corp., Oak Ridge, TN (United States)); Blair, M.S.; Nyquist, J.E. Oak Ridge National Lab., TN (United States). [1992]. 19p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. From Symposium on application of geophysics to engineering and environmental problems; Oakbrook, IL (United States); 26-29 Apr 1992. Order Number DE93001363. Source: OSTI; NTIS; INIS; GPO Dep.

This paper describes two recent case histories in which commercially available geophysical instruments were used with an innovative tracking and mapping system called USRADS (UltraSonic Ranging And Data System) that automates data location and collection. USRADS uses ultrasonics to provide real-time surveyor positioning and radio links to transmit the surveyor data to an on-site computer for storage and real-time display. USRADS uses a standard 386 computer for data collection and includes real-time color display of the findings. It also includes numerous analysis and display formats for on-site, as well as utilities to facilitate post-process analysis of the findings. The objective of one project was to locate several suspect waste disposal trenches and to map their boundaries. The second was to locate and map the presence of subsurface unexploded ordinance (UXO) at a suspect artillery impact area. A Geonics EM31 terrain conductivity meter interfaced to USRADS was used to map the suspect trenches. A Schonstedt GA-52C magnetometer interfaced to USRADS was used to map the subsurface UXO. Correlation of findings to known site features and additional knowledge about the sites indicates that these efforts did locate and map the geophysical features including the suspect waste trenches and the subsurface UXO. Images of the findings generated on-site and during post-processing are included.

4172 (CONF-9205261–1) **Modeling socioeconomic and ecologic aspects of land-use change: A case study of Central Rondonia.** Dale, V.H.; Pedlowski, M.A.; O'Neill, R.V.; Southworth, F. Oak Ridge National Lab., TN (United States). [1992]. 7p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. From FOREST '92: 2nd international symposium on environmental studies of tropical rain forests; Rio de Janeiro (Brazil); 24-29 May 1992. Order Number DE93001370. Source: OSTI; NTIS; INIS; GPO Dep.

Land use change is one of the major factors affecting global environmental conditions. Prevalent types of land-use change include replacing forests with agriculture, mines or ranches; forest degradation from collection of firewood; and forest logging. A global effect of wide-scale deforestation is an increase in atmospheric carbon dioxide concentration, which may affect climate. Regional effects include loss of biodiversity and disruption of hydrologic regimes. Local effects include soil erosion, siltation and decreases in soil fertility, loss of extractive reserves, and disruption of indigenous people. Modeling land use change requires combining socioeconomic and ecological factors because socioeconomic forces frequently initiate land-use change and are affected by the subsequent ecological degradation. This paper describes a modeling system that integrates submodels of human colonization and impacts to estimate patterns and rates of deforestation under different immigration and land use scenarios. Immigration which follows road building or paving is a major factor in the rapid deforestation of previously inaccessible areas. Roads facilitate colonization, allow access for large machines, and provide transportation routes for mort of raw materials and produce.

4173 (CONF-9208157–1) **Effect of chemical form of mercury on the performance of dosed soils in standard leaching tests: EP and TCLP.** Turner, R.R. Oak Ridge National Lab., TN (United States). [1992]. 7p. Sponsored by USDOE, Washington, DC (United States); Environmental Protection Agency, Washington, DC (United States). DOE Contract AC05-84OR21400. From Arsenic and mercury workshop on removal, recovery, treatment and disposal; Alexandria, VA (United States); 17-20 Aug 1992. Order Number DE93000442. Source: OSTI; NTIS; INIS; GPO Dep.

There are few regulatory and/or advisory criteria for mercury in contaminated soils, sediment, and waste. The most widely applied criterion for mercury in solid material is the performance of solid samples analyzed with leaching procedures developed by the US Environmental Protection Agency (EPA). These protocols, along with others, have been used to classify wastes under the Resource Conservation and Recovery Act (RCRA). Leaching results, expressed as the concentration of mercury in the laboratory-generated leachate, are compared to 200 μg/L. Results above this criterion are classified as having failed the RCRA "toxicity characteristic." The 200 μg/L limit represents 100 times the Drinking Water Standard for mercury and requires the sample to contain at least 4 μg/g. The latter value is derived by multiplying the established limit, 200 μg/L, by the solution-to-solid ratio in the test, 0.02 L/g. Objectives of this study were to determine which forms of mercury in soil exhibit the highest leachability as analyzed by the EP and TCLP protocols and to determine whether headspace mercury vapor readings from soil samples are indicative of leaching performance. The four mercury compounds studied were elemental mercury (Hg^0), mercuric sulfide (HgS), mercuric oxide (HgO), and mercurous oxide (Hg_2O). Whether the two leaching procedures yield equivalent results was also addressed.

4174 (CONF-9208167–1) **Soil organic matter dynamics and the global carbon cycle.** Post, W.M.; Emanuel, W.R.; King, A.W. Oak Ridge National Lab., TN (United States). [1992]. 17p.

Sponsored by USDOE, Washington, DC (United States); National Aeronautics and Space Administration, Washington, DC (United States). DOE Contract AC05-84OR21400. Grant NAGW-2660. From International workshop on world inventory; Wageningen (Netherlands); 24-27 Aug 1992. Order Number DE93001367. Source: OSTI; NTIS; INIS; GPO Dep.

The large size and potentially long residence time of the soil organic matter pool make it an important component of the global carbon cycle. Net terrestrial primary production of about 60 Pg $C \cdot yr^{-1}$ is, over a several-year period of time, balanced by an equivalent flux of litter production and subsequent decomposition of detritus and soil organic matter. We will review many of the major factors that influence soil organic matter dynamics that need to be explicitly considered in development of global estimates of carbon turnover in the world's soils. We will also discuss current decomposition models that are general enough to be used to develop a representation of global soil organic matter dynamics.

4175 (DOE/BP–1948) **Proposed plan for remedial action at Ross Complex (Superfund) Site, Operable Unit A.** USDOE Bonneville Power Administration, Portland, OR (United States). Aug 1992. 9p. Sponsored by USDOE, Washington, DC (United States). Order Number DE92040932. Source: OSTI; NTIS; GPO Dep.

This Proposed Plan identifies the preferred options and summaries of other alternatives considered for cleaning up contaminated soils at the Bonneville Power Administration (BPA) Ross Complex located in Vancouver, Washington (Clark County). BPA, the US Environmental Protection Agency (EPA), and the Washington State Department of Ecology (Ecology) are seeking comments from the public on all alternatives in this proposed plan. The alternative to be used will not be selected until the public comment period has ended and all comments have been received and considered. The site is divided into two operable units, A and B. Operable Unit A addresses site soils and Operable Unit B will focus on potential surface water, ground water, and limited soils investigation. Operable Unit B will be completed in June 1993. This Proposed Plan is for Operable Unit A. This Proposed Plan is provided to encourage public participation in the clean up decision-making process in accordance with section 117(a) of the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA). This Plan briefly summarizes available information contained in the Remedial Investigation/Feasibility Study (RI/FS) and other documents contained in the administrative record for this site.

4176 (DOE/CH–9210) **Predicted performance of systems for Bulk Soil Assay, Barrel Inspection, and Decommissioning: Final report.** Aitken, A.H.; Peters, C.W. Nuclear Diagnostic Systems, Inc., Lorton, VA (United States). Nov 1991. 46p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-31109-ENG-38. Order Number DE93002045. Source: OSTI; NTIS; INIS; GPO Dep.

In this project performances are predicted for new neutron interrogation systems designed to detect pollutant elements, uranium and transuranics (TRU), and gamma-ray emitters for Bulk Soil Assay, Barrel Inspection, and Decommissioning problems in the DOE Environment Restoration program. These new systems, which are based on the associated-particle time-of-flight (APTOF) technology are expected to save up to four times their $1.00 per hour operating costs relative to their alternatives for these problems. The key component required for practical use of the APTOF technology is a small sealed-tube neutron-generator (STNG) that incorporates a position sensitive alpha detector used to sense the alpha particle associated with emission of a 14-MeV neutron in the (D,T) reaction. The STNG makes possible a unique Inelastic-Gamma Imaging and Spectroscopy (IGRIS) system which provides a coarse three-dimensional image of the densities of elements in a target. Additional measurement capabilities as Capture-Gamma Ray Spectroscopy (CGRS) carried out simultaneously with IGRIS, Passive (STNG off) Gamma Ray Spectroscopy (PGRS), and Gamma-Ray Coincidence Spectroscopy (GRCS) carried out simultaneously with IGRIS, CGRS, and PGRS. These measurements are complementary and synergistic with each other. For example, the imaging capability of IGRIS can be used to estimate neutron and gamma-ray attenuations to correct any of these measurements. Predicted minimum detectable levels (MDLS) for several elements and radionuclides were measured and are presented.

4177 (DOE/CH–9214) **Chromate reduction and heavy metal fixation in soil: Final report.** Schwitzgebel, K. Sizemore Technical Services, Inc., Round Rock, TX (United States). Jun 1992. 63p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-31109-ENG-38. Order Number DE93002266. Source: OSTI; NTIS; INIS; GPO Dep.

In situ reduction of chromates and the fixation of the metals Cr, Pb, Zn, Cu, Cd and Ni in soil was investigated using Fe II and soluble silica. Fe II fulfills two functions. It reduces chromates (CrVI) at soil pH to CrIII and the reaction products, $Fe(OH)_3$ and $Cr(OH)_3$, coprecipitate/adsorb heavy metals. In the absence of CrVI iron is added as FeIII. Destabilized silica also fulfills two functions. It reacts with the metal and metal hydroxides and reduces the soil permeability. The leaching rate (mg/m^2s) of a metal is the product of leachate flow rate (ℓ/M^2s) and the leachate concentration (mg/ℓ). The leachate flow rate is directly proportional to the hydraulic coefficient (Darcy's Law). Treatment with destabilized silica reduces the hydraulic coefficient of virgin soil ($K_h = 10^{-2}...10^{-4}$) to $K_h=10^{-7}$ (cm/s) resulting in a flow rate reduction of 3–5 orders of magnitude. Iron plus silica treatment results in a leachate concentration reduction of up to 2 orders of magnitude (Cr:95–99%;Pb:99%;Zn 95–99%; Cd:93–99%; Ni:75–94%). Combined effect of flow rate reduction and leachate concentration reduction results in a potential leaching rate reduction of five to seven orders of magnitude. Iron-silica treatment may be developed into an efficient containment technology, provided the silica gel integrity does not change with time.

4178 (DOE/ER/30196–1) **Organic acid modeling and model validation: Workshop summary: Final report.** Sullivan, T.J.; Eilers, J.M. E and S Environmental Chemistry, Inc., Corvallis, OR (United States). 14 Aug 1992. 47p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG02-92ER30196. (CONF-9204207–Summ.: Organic acid modeling and model validation workshop, Corvallis, OR (United States), 9-10 Apr 1992). Order Number DE93001862. Source: OSTI; NTIS; GPO Dep.

A workshop was held in Corvallis, Oregon on April 9–10, 1992 at the offices of E&S Environmental Chemistry, Inc. The purpose of this workshop was to initiate research efforts on the entitled "Incorporation of an organic acid representation into MAGIC (Model of Acidification of Groundwater in Catchments) and testing of the revised model using Independent data sources." The workshop was attended by a team of internationally-recognized experts in the fields of surface water acid-bass chemistry, organic acids, and watershed modeling. The rationale for the proposed research is based on the recent comparison between MAGIC model hindcasts and paleolimnological inferences of historical acidification for a set of 33 statistically-selected Adirondack lakes. Agreement between diatom-inferred and MAGIC-hindcast lakewater chemistry in the earlier research had been less than satisfactory. Based on preliminary analyses, it was concluded that incorporation of a reasonable organic acid representation into the version of MAGIC used for hindcasting was the logical next step toward improving model agreement.

4179 (DOE/ER/60743–3) **Water Science and Technology Board annual report, 1990.** National Research Council, Washington, DC (United States). Water Science and Technology Board. 1990. 42p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG05-89ER60743. Order Number DE93002801. Source: OSTI; NTIS; GPO Dep.

This report summarizes the activities of the Water Science and Technology Board (WSTB) during 1990, its eighth year of existence. It describes current and recently completed projects, new activities scheduled to begin in 1991, and plans for the future. The WSTB is intended to be a dynamic forum, a mechanism by which the board community of water science, technology, and policy professionals can help assure high-quality national water programs. As such, the Board considers out-reach and communications of much importance.

4180 (DOE/ER/60775–T1) **Water use, productivity and interactions among desert plants.** Ehleringer, J.R. Utah Univ., Salt Lake City, UT (United States). Dept. of Biology. 17 Nov 1992. 23p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG02-89ER60775. Order Number DE93004643. Source: OSTI; NTIS; GPO Dep.

Water plays a central role affecting all aspects of the dynamics in aridland ecosystems. Productivity, stability, and competitive interactions among ecosystem components within aridlands are key processes related directly to water in deserts. The ecological studies in this project revolve around one fundamental premise: that integrated aspects of plant metabolism provide insight into the structure and function of plant communities and ecosystems. While it is difficult to extrapolate from instantaneous physiological observations to higher scales, such as whole plant performance or to interactions between plants as components of ecosystems, several key aspects of plant metabolism are scalable. Analyses of stable isotopic composition in plant tissues at natural abundance levels provide a useful tool that can provide insight into the consequences of physiological processes over temporal and spatial scales. Some plant processes continuously fractionate among light and heavy stable isotopic forms of an element; over time this results in integrated measures of plant metabolism. For example, carbon isotope fractionation during photosynthesis results in leaf carbon isotopic composition that is a measure of the set-point for photosynthetic metabolism and of water-use efficiency. Thus it provides information on the temporal scaling of a key physiological process. In contrast, hydrogen is not fractionated during water uptake through the root. Soil water availability in shallow, deep, and/or groundwater layers vary spatially; therefore hydrogen isotope ratios of xylem sap provide a direct measure of the water source currently used by a plant. The longer-term record of carbon and hydrogen isotope ratios is recorded annually in xylem tissues (tree rings). The research in this project addresses variation in stable isotopic composition of aridland plants and its consequences for plant performance and community-level interactions.

4181 (DOE/ER/60988–T1) **Biomass, community structure and nutritional status attributes of the deep subsurface microbiota—at Idaho and Hanford sites.** White, D.C. (Tennessee Univ., Knoxville, TN (United States). Center for Environmental Biotechnology); Ringelberg, D.B. Tennessee Univ., Knoxville, TN (United States). Center for Environmental Biotechnology. 28 Oct 1991. 18p. Sponsored by USDOE, Washington, DC (United States); Department of Defense, Washington, DC (United States); Electric Power Research Inst., Palo Alto, CA (United States); National Aeronautics and Space Administration, Washington, DC (United States); Nationa DOE Contract FG05-90ER60988. Order Number DE93003594. Source: OSTI; NTIS; GPO Dep.

The signature lipid biomarker technique based on phospholipid ester-linked fatty acid pattern analysis (PLFA) provides data on the total viable or potentially viable communities without the necessity of: (1) Quantitative recovery from the sediments or (2) The ability to culture the organisms. Analysis of PLFA provides evidence for the nutritional status (starvation and/or unbalanced growth) in situ. PLFA analysis of SSP samples from the INEL and PNL sites vadose zones showed higher biomass at the surface with prominent Actinomyces biomarkers with lower biomasses of stressed microbiota at progressively greater depth. The biomass and community diversity increased at the water table at both sites. Both these Western sites showed lower viable microbial biomasses than the WSRS samples. Cluster analysis of the total patterns from various sedimentary horizons showed three major consortia of microbes, with surface microbiota related at both sites, low viable biomass sites closely related at both sites, with anaerobic desaturase pathway being predominant at INEL and consortia utilizing predominantly branched saturated and the aerobic desaturase pathway at both sites. Preliminary examination of the consortia recovered from NTS show a clear relationship to water level.

4182 (DOE/ER/75637–1) **Greenhouse Earth: A Traveling Exhibition: Final report, September 1, 1991–August 31, 1992.** Booth, W.H.; Caesar, S. Franklin Inst., Philadelphia, PA (United States). Science Museum. Sep 1992. 8p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG02-91ER75637. Order Number DE93002419. Source: OSTI; NTIS; INIS; GPO Dep.

The Franklin Institute Science Museum provided an exhibit entitled the Greenhouse Earth: A Traveling Exhibition. This 3500 square-foot exhibit on global climate change was developed in collaboration with the Association of Science-Technology Centers. The exhibit opened at The Franklin Institute on February 14, 1992, welcoming 291,000 visitors over its three-month stay. During its three-year tour, Greenhouse Earth will travel to ten US cities, reaching two million visitors. Greenhouse Earth aims to deepen public understanding of the scientific issues of global warming and the conservation measures that can be taken to slow its effects. The exhibit features hands-on exhibitry, interactive computer programs and videos, a theater production, a "demonstration cart," guided tours, and lectures. supplemental educational programs at the Institute included a teachers preview, a symposium on climate change, and a "satellite field trip." The development of Greenhouse Earth included front-end and formative evaluation procedures. Evaluation includes interviews with visitors, prototypes, and summative surveys for participating museums. During its stay in Philadelphia, Greenhouse Earth was covered by the local and national press, with reviews in print and broadcast media. Greenhouse Earth is the first large-scale museum exhibit to address global climate change.

4183 (DOE/NV/10630–23) **CASCADER: An m-chain gas-phase radionuclide transport and fate model: Volume 1, Basic physics and mathematics.** Lindstrom, F.T.; Cawlfield, D.E.; Emer, D.F.; Shott, G.J.; Donahue, M.E. Reynolds Electrical and Engineering Co., Inc., Las Vegas, NV (United States). Jun 1992. 92p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC08-89NV10630. Order Number DE93001390. Source: OSTI; NTIS; INIS; GPO Dep.

Chemicals and radionuclides move either in the gas-phase, liquid-phase, or both phases in soils. They may be acted upon by either biological or abiotic processes as they are advected and/or dispersed. Furthermore, parent and daughter radionuclides may decay as they are transported in the soil. CASCADER is a gas-phase, one space dimensional transport and fate model for an m-chain of radionuclides in very dry soil. This model contains barometric pressure-induced advection and diffusion together with linear irreversible and linear reversible sorption for each radionuclide. The advocation velocity is derived from an embedded air-pumping submodel. The airpumping submodel is based on an assumption of isothermal conditions and is barometric pressure driven. CASCADER allows the concentration of source radionuclides to decay via the classical Bateman chain of simple, first-order kinetic processes. The transported radionuclides also decay via first-order processes while in the soil. A mass conserving, flux-type inlet and exit set of boundary conditions is used. The user must supply the initial distribution for the parent radionuclide in the soil. The initial daughter distribution is found using equilibrium rules. The model is user friendly as it uses a prompt-driven, free-form input. The code is ANSI standard Fortran 77.

4184 (DOE-RW–89-091) **The location of uranium in source rocks and sites of secondary deposition at the Needle's Eye natural analogue site, Dumfries and Galloway.** Basham, I.R. (British Geological Survey, Edinburgh (United Kingdom)); Hyslop, E.K.; Milodowski, A.E.; Pearce, J.M. Department of the Environment, London (United Kingdom). Her Majesty's Inspectorate of Pollution. Aug 1989. 56p. Contract WE/89/56. (PECD–7-9-367.). Order Number DE93607139. Source: OSTI; NTIS (US Sales Only); INIS.

The British Geological Survey has been conducting a co-ordinated research programme at the natural analogue site of Needle's Eye at Southwick on the Solway coast in SW Scotland. This study of a naturally radioactive geochemical system has been carried out with the aim of improving our confidence in using predictive models of radionuclide migration in the geosphere. This report describes results of integrated mineralogical techniques which have been applied to the study of both the 'source-term' and sites of secondary accumulation of uranium. Pitchblende in a polymetallic-carbonate breccia vein exposed in ancient sea-cliffs is the main source of labile uranium although other uranium-bearing

minerals present in the granodiorite and hornfelsed siltstone host-rocks present probable ancillary leachable sites. In keeping with the complex chemistry of the primary sulphide-rich mineralization, a large variety of secondary U minerals has been recorded among which arsenates and hydrous silicates appear to predominate. Uranium transported in groundwaters draining the cliffs has accumulated in organic-rich estuarine/intertidal mudflat sediments of Quaternary age. Charged particle track registration techniques have demonstrated convincingly the effectiveness of humidified organic matter in retarding uranium transport and, coupled with scanning electron microscopy, have indicated an important role of living plants and bacteria in uranium uptake and concentration. (author).

4185 (EGG–10617-1154) **An aerial radiological survey of the Portsmouth Gaseous Diffusion Plant and surrounding area, Portsmouth, Ohio: Date of survey: July 1990.** EG and G Energy Measurements, Inc., Las Vegas, NV (United States). Remote Sensing Lab. Sep 1992. 12p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC08-88NV10617. Order Number DE93003327. Source: OSTI; NTIS; INIS; GPO Dep.

An aerial radiological survey was conducted from July 11–20, 1990, over an 83-square-kilometer (32-square-mile) area surrounding the Portsmouth Gaseous Diffusion Plant located near Portsmouth, Ohio. The survey was conducted at a nominal altitude of 91 meters (300 feet) with line spacings of 122 meters (400 feet). A contour map of the terrestrial gamma exposure rate extrapolated to 1 meter above ground level (AGL) was prepared and overlaid on an aerial photograph and a set of United States Geological Survey (USGS) topographic maps of the area. The terrestrial exposure rates varied from about 7 to 14 microroentgens per hour (μR/h) at 1 meter above the ground. Analysis of the data for man-made sources and for the uranium decay product, protactinium-234m (^{234m}Pa), showed five sites within the boundaries of the Portsmouth Gaseous Diffusion Plant with elevated readings. Spectra obtained in the vicinity of the buildings at the Portsmouth Gaseous Diffusion Plant showed the presence of ^{234m}Pa, a uranium-238 (^{238}U) decay product. In addition, spectral analysis of the data obtained over the processing plant facility showed gamma activity indicative of uranium-235 (^{234}U). No other man-made gamma ray emitting radioactive material was detected, either on or off the Portsmouth Gaseous Diffusion Plant property. Soil samples and pressurized ion chamber measurements were obtained at five different locations within the survey boundaries to support the aerial data.

4186 (ES/ER/TM–26/R1) **Project plan for the Background Soil Characterization Project on the Oak Ridge Reservation, Oak Ridge, Tennessee.** Oak Ridge National Lab., TN (United States). Aug 1992. 159p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. Order Number DE93000788. Source: OSTI; NTIS; INIS; GPO Dep.

Environmental Sciences Division Publication 3818.

The Background Soil characterization Project (BSCP) will provide background concentration levels of selected metals, organic compounds, and radionuclides in soils from uncontaminated on-site areas at the Oak Ridge Reservation (ORR), and off-site in the western part of Roane County and the eastern part of Anderson County. The BSCP will establish a database, recommend how to use the data for contaminated site assessment, and provide estimates of the potential human health and environmental risks associated with the background level concentrations of potentially hazardous constituents.

4187 (ETDE-mf–93728810) **Highly volatile halogenated hydrocarbons in subsurface systems. Biotic-abiotic degradation and elimination. A literature study.** WaBoLu-Hefte. Wendland, F.; Leschber, R. Bundesgesundheitsamt, Berlin (Germany). Inst. fuer Wasser-, Boden- und Lufthygiene. 1990 76p. (In German). Order Number DE93728810. Source: OSTI; NTIS (US Sales Only).

Biodegradation of halogenated hydrocarbons (HC) is one possible natural pathway for elimination from the environment next to abiotic degradation processes and elimination pathways. At the same, different microbially controlled geochemical processes take place underground which may be assumed to be linked in a certain way to the biotic degradation of HC's. Knowledge about biotic degradation processes should not be underrated for its significance in the treatment of HC-contaminations by means of microorganisms. (orig.) With 23 figs., 12 tabs.

4188 (IAEA-NAHRES–3, pp. 14.1-14.2) **Application of nuclear techniques in agro-environmental science and protection in China.** Sun Laiyan (Institute for Application of Atomic Energy, Beijing, BJ (China)). International Atomic Energy Agency, Vienna (Austria). Section of Nutritional and Health-Related Environmental Studies. 1990. (CONF-8911339–: 3. research co-ordination meeting on nuclear techniques for toxic elements in foodstuffs, Jakarta (Indonesia), 20 Nov 1989). In *Co-ordinated research programme on nuclear techniques for toxic elements in foodstuffs: Report on the third research co-ordination meeting, Jakarta, Indonesia, 20-24 November 1989.* 184p. Order Number DE93606507. Source: OSTI; NTIS (US Sales Only); INIS.

Short communication. 3 refs. AGRICULTURE/tracer techniques; CHINA/agriculture; AGRICULTURE; CHINA; LAND POLLUTION; MONITORING; NEUTRON ACTIVATION ANALYSIS; WASTE WATER

4189 (IC–92/98) **Inversion of resistivity soundings in the archaeological site of Mahilaka (North-West of Madagascar) using the generalized linear inverse method.** Ratsimbazafy, J.B. (International Centre for Theoretical Physics, Trieste (Italy)); Randrianambinina, E. International Centre for Theoretical Physics, Trieste (Italy). Jul 1992. 12p. Order Number DE93607100. Source: OSTI; NTIS (US Sales Only); INIS.

This paper describes the generalized inverse method which is used for the inversion of resistivity sounding. The technique has been applied to a resistivity soundings survey whose stations are selected in the zones of resistivity anomalies over an archaeological site. The site covers an area of 0.75 square kilometer in the north-western part of Madagascar, bordering the east Mozambic Channel. The one-dimensional (1-D) model fits well the observed data and the generalized linear inverse method appears to be a powerful scheme with which to interpret resistivity sounding data. (author). 29 refs, 6 figs.

4190 (IEN-DIAPQ–001/89) **Contribution to the knowledge of metamict minerals.** Baptista, A.; Baptista, N.R. Instituto de Engenharia Nuclear (IEN), Rio de Janeiro, RJ (Brazil). 5 Oct 1989. 94p. (In Portuguese). Order Number DE93607113. Source: OSTI; NTIS (US Sales Only); INIS.

The used techniques in different analysis about metamict minerals, its results and conclusions. These samples went on Minas Gerais State, and they belong at the mineralogical collection of National Museum is presented. (C.M.).

4191 (INIS-BR–2938, pp. 21) **Organic geochemical evaluation of the Parana basin.** Cerqueira, J.R. (PETROBRAS, Rio de Janeiro, RJ (Brazil). Centro de Pesquisas); Santos Neto, E.V. dos. Sao Paulo Univ., SP (Brazil). Inst. de Geociencias. 1988. 156p. (CONF-8807219–: 7. Gondwana symposium, Sao Paulo (Brazil), 18 Jul 1988). In *Proceedings of the 7. Gondwana Symposium - Abstracts.* Order Number DE93606510. Source: OSTI; NTIS (US Sales Only); INIS.

Published in summary form only. ROCKS/geochemistry; BRAZIL; CARBON 13; EVALUATION; GEOLOGY; HYDROCARBONS; OILS; ROCKS; GEOCHEMISTRY

4192 (INIS-BR–2966) **Determination in soils of soluble uranium fraction in acid medium by fission tracks registration techniques.** Fernandes, G.P. Instituto Militar de Engenharia (IME), Rio de Janeiro, RJ (Brazil). 1980 125p. (In Portuguese). Order Number DE93607114. Source: OSTI; NTIS (US Sales Only); INIS.

The fission tracks registration technique was used to determine the concentration of uranium in soil solutions. The Makrofol KG, a synthetic plastic manufactured by Bayer, was used as a detector and the wet method was applied. The method was applied to a few samples of soils from Pocos de Caldas, Minas Gerais in Brazil. The concentrations of uranium in the samples and residues were also determined by other methods to compare the results obtained; only one sample showed deviation among the results obtained by the fission tracks method. (author).

4193 (INIS-BR–2969) **Determination of some main elements and traces by x-ray fluorescence analysis in silicate**

rocks: a comparative study of two analytical techniques. Andrade, M.D. de. Bahia Univ., Salvador, BA (Brazil). 1977 127p. (In Portuguese). Order Number DE93607115. Source: OSTI; NTIS (US Sales Only); INIS.

The determinations of silicon, magnesium, iron, potassium, calcium, titanium, manganese, barium, strontium, rubidium, zirconium and scandium in felsic and mafic rocks, by X ray fluorescence analysis are presented. (author).

4194 (INIS-BR–3013) **Geophysical studies of ilmenite and monazite placers in Itaparica Island - Bahia State.** Cerqueira Neto, J.X. Bahia Univ., Salvador, BA (Brazil). 1976 112p. (In Portuguese). Order Number DE93607116. Source: OSTI; NTIS (US Sales Only); INIS.

A ground scintillometric survey along the southern shores of the island of Itaparica, Bahia, Brazil, discovered numerous anomalies. Detailed geophysical and sedimentological studies proved that the major anomaly is due to an ilmenite placer deposit. A comparison of the field geophysical measurements (ground scintillometry, magnetics and induced polarization) with the laboratory samples suggests the following: (i) Ground scintillometry is suitable for locating and delineating such placer deposits. (ii) Induced polarization is useful to investigate the deposit at depth. (iii) Magnetic surveys were not particularly useful in spite of the high ilmenite concentration, thus they do not appear to be a helpful survey tool in this case. A more extensive prospecting program in the Brazilian coastal areas particularly in the State of Bahia are also proposed. (author).

4195 (INIS-BR–3018) **Simultaneous bulk density and soil moisture determination by attenuation of ^{137} Cs and ^{241} Am.** Barros Ferraz, E.S. de. Sao Paulo Univ., Piracicaba, SP (Brazil). Escola Superior de Agricultura Luiz de Queiroz. 1974 129p. (In Portuguese). Order Number DE93607117. Source: OSTI; NTIS (US Sales Only); INIS.

The method of simultaneous bulk density and soil moisture determination by attenuation of ^{241} Am and ^{137} Cs gamma-radiation is introduced and studied with detail. Theoretical considerations are made about the attenuation process in the absorbers, the form of solving the problem of two unknowns, the sensitivity of the method the influences of the resolution time of the electronic counting equipment, and of the Compton scattering in the sample. From the methodological point of view studies are made about the influence of the geometry, adjustment of counting system, choice of radiation sources, attenuation coefficient and the manner of obtaining reliable measurements. Data obtained are analysed, discussed and compared with those found in the literature. Finally the author presents some applications of the method, its use in soil-water movement studies, in soil profile compaction studies, and specially in swelling soils. (author).

4196 (INIS-BR–3049) **Characterization of Rn-222 production in Campo do Cercado C/09 Pocos de Caldas, Minas Gerais State.** Pereira, E.B. Sao Paulo Univ., SP (Brazil). Inst. Astronomico e Geofisico. 1977 128p. (In Portuguese). Order Number DE93607104. Source: OSTI; NTIS (US Sales Only); INIS.

A systematic study for correlating the Rn-222 escape with the main geochemical and mineralogical factors for understanding of some change processes from uranium deposits in Campo do Cercado C-09 in Pocos de Caldas, Minas Gerais State is described. (author).

4197 (INIS-mf–14091) **Radiation monitoring in the surroundings of the nuclear facilities of Baden-Wuerttemberg. Annual report 1990.** Landesanstalt fuer Umweltschutz Baden-Wuerttemberg, Karlsruhe (Germany). 1991 278p. (In German). Order Number DE93729096. Source: OSTI; NTIS (US Sales Only); INIS.

Measurements of the radioactivity of environmental samples (air, water, food chains, direct radiation) were taken by Landesanstalt fuer Umweltschutz for determination and monitoring of the ground level concentrations of pollutants in the surroundings of nuclear facilities. The 1990 results obtained for the sites of Baden-Wuerttemberg were compiled and published. The individual measurements are listed for each site by the samples taken and by quarters of the year. (BBR).

4198 (INIS-mf–14092) **Radiation monitoring in the surroundings of the nuclear facilities of Baden-Wuerttemberg. Annual report 1991.** Landesanstalt fuer Umweltschutz Baden-Wuerttemberg, Karlsruhe (Germany). 1992 290p. (In German). Order Number DE93729097. Source: OSTI; NTIS (US Sales Only); INIS.

Measurements of the radioactivity of environmental samples (air, water, food chains, direct radiation) were taken by Landesanstalt fuer Umweltschutz for determination and monitoring of the ground level concentrations of pollutants in the surroundings of nuclear facilities. The 1991 results obtained for the sites of Baden-Wuerttemberg were compiled and published. The individual measurements are listed for each site by the samples taken and by quarters of the year. (orig./BBR).

4199 (Juel–2624) **Extraction of PAH and PCB for sanitation of contaminated soils using supercritical fluids.** Sielschott, W. Forschungszentrum Juelich GmbH (Germany). Inst. fuer Chemie 4 - Angewandte Physikalische Chemie; Technische Hochschule Aachen (Germany). May 1992. 98p. (In German). Order Number DE93728904. Source: OSTI; NTIS (US Sales Only).

Supercritical PAH and PCB extraction was investigated in doped model soils and real sites of long-standing pollution. An existing extraction system was reconstructed for this purpose and modified for direct observation of the extraction kinetics. The influence of pressure, temperature and fluid density on extraction was determined. The extraction rate can be improved by adding a few per cent of methanol or ethanol as entrainer. A similar effect is achieved with dinitrogen oxide, which has a selective improving effect in the extraction of higher PAH as compared with CO_2. (orig.).

4200 (KAERI-NEMAC/RR–38/91) **Evaluation of structural behavior geological and hydrogeological characteristics: A study on the ground water flow and hydrogeological interaction in fractured rock masses.** Ahn, Jong Sung (Korea Atomic Energy Research Inst., Daeduk (Korea, Republic of)); Kim, Chun Soo; Yun, Si Tae; Kim, Sun Joon; Kim, Gye Nam; Jung, Chan Ho; Kim, Jin Se. Korea Atomic Energy Research Inst., Daeduk (Korea, Republic of). Mar 1992. 149p. (In Korean). Order Number DE93607140. Source: OSTI; NTIS (US Sales Only); INIS.

Characterization of groundwater flow system and geochemistry of Gneissic rock in the vicinity of Chungyang area, an imaginary nuclear waste repository site, was carried out. Mineralogical, chemical compositions and textures of country rock and fracture-filling minerals were analyzed by petrological microscope, X-ray diffractometer and electron micro-probe analyzer. Such petrological and mineralogical properties of gneissic rock can serve as a database for the study of retardation of radioactive nuclide transport. Characteristics and interactions among rain water, surface water and groundwater were discussed based on chemical and isotope compositions of water samples. In-situ hydraulic dispersion test using tritium was carried out and the result was compared to that of NaCl. Hydraulic head distribution, flow time, flow direction and flow rate were calculated using a numerical model, FEMWATER, which were verified by another model, TRAFRAP. Since the flow times of groundwater from surface to groundwater table were calculated to be 17 and 27 year, depending on flow paths respectively, it is expected that the area down to EL.(+)220m from the surface is unsafe for the construction of waste repository. (Author).

4201 (KFK-PEF–93) **Uptake and localization of nutritive and potentially toxic minerals in ectomycorrhizas of forest trees.** Kottke, I. (Tuebingen Univ. (Germany). Botanisches Inst.); Oberwinkler, F. Kernforschungszentrum Karlsruhe GmbH (Germany). Projekt Europaeisches Forschungszentrum fuer Massnahmen zur Luftreinhaltung (PEF). May 1992. 28p. (In German). Contract EC 87/010/1A. Order Number DE93728952. Source: OSTI; NTIS (US Sales Only).

Mycorrhizas of Norway spruce were analysed by means of electron energy loss spectroscopy (EELS/ESI) on TEM 902 ZEISS in respect to distribution of aluminium, calcium, phosphorus and cadmium after exposure of the objects to enhanced concentrations of the elements. Exclusion mechanism in mycorrhizas for aluminium and other toxic elements can be derived from the results and reveal buffering capacity for noxic soil ions attained by mycorrhization. Polyphosphates in hyphal vacuoles are shown to be important

sites for detoxification. The precise localization of elements yields valuable information not otherwise attainable. (orig.) With 20 figs., 61 refs.

4202 (LA–12195-MS) **Determination of 100-year floodplain elevations at Los Alamos National Laboratory.** McLin, S.G. Los Alamos National Lab., NM (United States). Aug 1992. 83p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. Order Number DE93001895. Source: OSTI; NTIS; GPO Dep.

Includes MOSS source codes and data files on two 3.5 inch diskettes.

Under existing permit requirements. the US Environmental Protection Agency stipulates that facilities regulated by the Resource Conservation and Recovery Act must delineate all 100-yr floodplain elevations within their boundaries. At Los Alamos these floodplains are located within ungaged watersheds that drain Pajarito Plateau. This report documents the floodplain computational mapping procedure and, along with supporting maps, is untended to satisfy this permit requirement.

4203 (LBL–32021) **Alternative formulations of the Laplace transform boundary element (LTBE) numerical method for the solution of diffusion-type equations.** Moridis, G. Lawrence Berkeley Lab., CA (United States). Mar 1992. 19p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC03-76SF00098. (CONF-920664–2: 7. international conference on boundary element technology, Albuquerque, NM (United States), 3-5 Jun 1992). Order Number DE92041172. Source: OSTI; NTIS; GPO Dep.

The Laplace Transform Boundary Element (LTBE) method is a recently introduced numerical method, and has been used for the solution of diffusion-type PDEs. It completely eliminates the time dependency of the problem and the need for time discretization, yielding solutions numerical in space and semi-analytical in time. In LTBE solutions are obtained in the Laplace spare, and are then inverted numerically to yield the solution in time. The Stehfest and the DeHoog formulations of LTBE, based on two different inversion algorithms, are investigated. Both formulations produce comparable, extremely accurate solutions.

4204 (NSS-R–213) **The use of tracer techniques in the study of soil water flows and contaminant transport.** Reeves, A.D. (Lancaster Univ. (United Kingdom). Centre for Research on Environmental Systems); Beven, K.J. United Kingdom Nirex Ltd., Harwell (United Kingdom). Apr 1990. 59p. (CRES-TR–8912/04.). Order Number DE93607105. Source: OSTI; NTIS (US Sales Only); INIS.

This report reviews the use of different types of tracers in the characterisation of soil water flows and the implications of tracer studies for modelling contaminant transport. The tracers considered are a number of different anions, stable isotopes, radioactive tracers, organic dyes, fluorocarbons, gases, solid particles and water temperature. The theoretical basis for modelling the results of tracer experiments in terms of the traditional convective-dispersion equation (CDE) is outlined. A number of alternative modelling strategies are reviewed: the mobile/immobile water extension of the CDE; the Jury Transfer Function Model (TFM); the Aggregated Mixing Zone (AMZ) model and Random Particle Tracking models. The first will form the basis of the Systeme Hydrologique Europeen (SHE) contaminant transport component. The Jury and AMZ models are both linear models and are consequently limited to applications in which the flows may be considered to be quasi-steady or repeatable. Random particle tracking models have the advantage of both flexibility and applicability to transient and spatially variable flow domains. A random particle model is being implemented on a transputer workstation at Lancaster and will be used to explore the effect of sub-grid scale complexities on effective grid-scale parameter values for distributed models such as SHE. (author).

4205 (NSS-R–269) **Laboratory studies of flow and transport in single fractures: Pt. 1: Artificial fracture and granite block experiments.** Braney, M.C. (AEA Decommissioning and Radwaste, Harwell (United Kingdom)); Cliffe, K.A.; Gilling, D.; Jefferies, N.L.; Lineham, T.R. United Kingdom Nirex Ltd., Harwell (United Kingdom). Jun 1991. 38p. Order Number DE93607106. Source: OSTI; NTIS (US Sales Only); INIS.

An assessment of the safety of disposing of radioactive waste in an underground repository requires an understanding of radionuclide transport mechanisms in the geosphere. In hard rocks, such as granite and slate, essentially all water flow takes place through a fracture network. This report describes two preliminary laboratory-scale experiments undertaken in order to develop a methodology for investigating flow and transport in single fractures. The first experiment was designed to investigate flow and transport in an 'artificial' sandstone fracture. The second experiment was designed to investigate flow and transport in a natural fracture in a granite block. Experimental data have been analysed using a mathematical model that describes flow and transport in a single fracture. In the case of the artificial fracture, good fits between experimental data and model predictions (including incorporation of rock-matrix diffusion) have been obtained. In the case of the natural granite fracture, discrepancies between data and model prediction have been demonstrated to be due to significant channelling of flow over the fracture surface. Finally, a number of areas where improvements should be made in future block-scale tracer migration experiments are discussed. (author).

4206 (ORNL/ER–124) **Annual report of the Environmental Restoration Monitoring and Assessment Program at Oak Ridge National Laboratory for FY 1992: Environmental Restoration Program.** Clapp, R.B. (ed.). Oak Ridge National Lab., TN (United States). Sep 1992. 211p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. Order Number DE93000588. Source: OSTI; NTIS; INIS; GPO Dep.

Environmental Sciences Division 3945.

This report summarizes the salient features of the annual efforts of the investigations and monitoring, conducted to support the Environmental Restoration (ER) Program at Oak Ridge National Laboratory (ORNL). The results presented can be used to develop a conceptual understanding of the key contaminants and the sources, fluxes, and processes affecting their distribution and movement. This information forms a basis for prioritizing sites and for selecting, implementing, and evaluating remedial actions. Groundwater, soils, sediments, and surface water monitoring results are described.

4207 (PNL–8300) **Sampling and analysis of sediments in dredged material from Wilma Uplands Disposal Site.** Pinza, M.R. (Battelle/Marine Sciences Lab., Sequim, WA (United States)); Karle, L.M.; Mayhew, H.L.; Word, J.Q. Pacific Northwest Lab., Richland, WA (United States). Sep 1992. 25p. Sponsored by Department of Defense, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE92041319. Source: OSTI; NTIS; GPO Dep.

The Lower Granite Reservoir provides slack-water navigation for the Lewiston, Idaho, and Clarkston, Washington area. The levee system associated with the reservoir protects industrial, commercial, and residential areas from inundation of waters impounded behind the dam. Sediment deposition at the confluence of the Snake and Clearwater rivers has required frequent dredging events In past years, Including two recent events in 1986 and 1987. Dredged material from the 1986 and 1987 events was placed in three containment ponds located on the north bank of the Snake River, near River Mile 134.7. The ponds were used to hold approximately 400,000 cubic yards of dredged material removed from the port areas at the confluence of the Snake and Clearwater rivers. Prior to dredging, the river sediments were tested and found to be typical of non-contaminated sediment. Since that testing, dioxins and furans have been found in the effluent from a Kraft pulp mill in Lewiston that discharges directly into the confluence of the Snake and Clearwater rivers. The US Army Corps of Engineers (USACE) believed that dredged material placed in the containment ponds may contain contaminated levels of dioxins and furans. At their request, Battelle/Marine Sciences Laboratory (MSL) sampled sediments from these ponds and performed a chemical analysis.

4208 (PNL-SA–20750) **Innovative technology demonstrations.** Anderson, D.B. (Pacific Northwest Lab., Richland, WA (United States)); Luttrell, S.P.; Hartley, J.N.; Hinchee, R. Pacific Northwest Lab., Richland, WA (United States). Aug 1992. 10p.

Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. (CONF-920851–80: Spectrum '92: nuclear and hazardous waste management international topical meeting, Boise, ID (United States), 23-27 Aug 1992). Order Number DE93001306. Source: OSTI; NTIS; INIS; GPO Dep.

Environmental Management Operations (EMO) is conducting an Innovative Technology Demonstration Program for Tinker Air Force Base (TAFB). Several innovative technologies are being demonstrated to address specific problems associated with remediating two contaminated test sites at the base. Cone penetrometer testing (CPT) is a form of testing that can rapidly characterize a site. This technology was selected to evaluate its applicability in the tight clay soils and consolidated sandstone sediments found at TAFB. Directionally drilled horizontal wells was selected as a method that may be effective in accessing contamination beneath Building 3001 without disrupting the mission of the building, and in enhancing the extraction of contamination both in ground water and in soil. A soil gas extraction (SGE) demonstration, also known as soil vapor extraction, will evaluate the effectiveness of SGE in remediating fuels and TCE contamination contained in the tight clay soil formations surrounding the abandoned underground fuel storage vault located at the SW Tanks Site. In situ sensors have recently received much acclaim as a technology that can be effective in remediating hazardous waste sites. Sensors can be useful for determining real-time, in situ contaminant concentrations during the remediation process for performance monitoring and in providing feedback for controlling the remediation process. Following the SGE demonstration, the SGE system and SW Tanks test site will be modified to demonstrate bioremediation as an effective means of degrading the remaining contaminants in situ. The bioremediation demonstration will evaluate a bioventing process in which the naturally occurring consortium of soil bacteria will be stimulated to aerobically degrade soil contaminants, including fuel and TCE, in situ.

4209 (UCRL-ID–112027) **Site characterization report for HRMP monitoring well UE20bh-1, Nye County, Nevada Test Site.** Boyd, O.S.; Wagoner, J.L.; Carlson, R.C. Lawrence Livermore National Lab., CA (United States). Jul 1992. 97p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. Order Number DE93003332. Source: OSTI; NTIS; GPO Dep.

This document is a summary of the geological investigation of and geophysical logging data acquired in well UE20bh-1 of the Hydrologic Radionuclide Migration Program (HRNP). It describes the geologic setting of the UE20bh-1 site and discusses each geophysical log and processing history. We also provide a preliminary correlation of the logging data with the stratigraphic section encountered in the drill hole.

4210 (VTT-SYMP–126) **Ground water modelling.** Leino-Forsman, H.; Olin, M. (eds.). Technical Research Centre of Finland, Espoo (Finland). 1991. 156p. (In Finnish). (CONF-9105387–: Seminar on ground water modelling, Espoo (Finland), 9 May 1991). Order Number DE93607107. Source: OSTI; NTIS; INIS.

The first Seminar on Groundwater Modelling was arranged by VTT (Reactor Laboratory) in Espoo Finland in May 1991. The one day seminar dealt both with modelling of geochemistry and transport of groundwater, as well as mathematical methods for modelling. The seminar concentrated on giving a broad picture of the applications of groundwater modelling e.g. nuclear waste, groundwater resources including artificial groundwater and pollution. The participants came from research institutes and universities as well as engineering companies. Articles are published in Finnish with English abstracts.

4211 (VTT-SYMP–126, pp. 122-127) **Use of groundwater models at the National Board of Waters and the Environment.** Granlund, K. (National Board of Waters and the Environment, Helsinki (Finland)). Technical Research Centre of Finland, Espoo (Finland). 1991. (In Finnish). (CONF-9105387–: Seminar on ground water modelling, Espoo (Finland), 9 May 1991). In *Ground water modelling.* 156p. Order Number DE93607107. Source: OSTI; NTIS; INIS.

The National Board of Waters and the Environment has carried out several studies to provide more information about the quantity and quality of Finnish groundwaters. At the beginning of 1990 a special project was set up at the technical research office to develop mathematical groundwater models suitable for Finnish hydrogeological conditions. Such models can be used for evaluating the drawdown of the groundwater table due to extraction and calculating the pathways of polluted groundwaters. Groundwater models are important tools in managing groundwater resources to meet long-term human and environmental needs.

4212 (WHC-EP–0573) **Westinghouse Hanford Company environmental surveillance annual report: Calendar year 1991.** Schmidt, J.W.; Johnson, A.R.; McKinney, S.M.; Perkins, C.J.; Webb, C.R. Westinghouse Hanford Co., Richland, WA (United States). Jul 1992. 378p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-87RL10930. Order Number DE93001668. Source: OSTI; NTIS; INIS; GPO Dep.

This document presents the results of near-facility operational environmental monitoring in 1991 of the 100, 200/600, and 300/400 Areas of the Hanford Site, in south-central Washington State, as performed by Westinghouse Hanford Company. These activities are conducted to assess and to control the impacts of operations on the workers and the local environment and to monitor diffuse sources. Surveillance activities include sampling and analyses of ambient air, surface water, groundwater, sediments, soil, and biota. Also, external radiation measurements and radiological surveys are taken at waste disposal sites, radiologically controlled areas, and roads.

4213 (WINCO–11860) **Sequential extraction evaluation of soil washing for radioactive contamination.** Gombert, D. Westinghouse Idaho Nuclear Co., Inc., Idaho Falls, ID (United States). [1992]. 13p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC07-84ID12435. (CONF-9209229–1: Industrial and engineering chemistry (I&EC) special symposium of the American Chemical Society (ACS), Atlanta, GA (United States), 21-23 Sep 1992). Order Number DE92041326. Source: OSTI; NTIS; INIS; GPO Dep.

This paper describes an experimental plan for evaluating soil washing technology for potential application to radioactively contaminated soils at the Idaho National Engineering Laboratory (INEL). The sequential extraction methodology is based on micronutrient bioavailability studies wherein the soil matrix is chemically dissected to selectively remove particular fixation mechanisms independently. A mechanism-specific extractant has the potential for greater removal efficiency than a broad-spectrum extractant, such as acid, while using a less aggressive chemistry and reducing resultant water treatment and dissolved solids handling problems.

4214 (WSRC-IM–91-28-Summ.) **Savannah River Site Environmental Report for 1990: Summary pamphlet.** Cummings, C.L.; Martin, D.K.; Todd, J.L. Westinghouse Savannah River Co., Aiken, SC (United States). [1991]. 23p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC09-89SR18035. Order Number DE93000455. Source: OSTI; NTIS; INIS; GPO Dep.

The SRS publishes the Environmental Report each year to communicate the endings of the environmental monitoring and research programs to the public and government agencies. This pamphlet is intended to summarize important environmental activities at the Savannah River Site in 1990. Highlights include: In 1990, over 40,000 samples of environmental material were collected for radiological and nonradiological analyses. The largest radiation doses to the surrounding population were from the radionuclide "tritium," which was released to air and water from SRS operations.; tritium concentrations measured near the site in air, rainwater, Savannah River water, milk from local dairies and downriver drinking water were higher than background levels; the maximum radiation dose to individuals offsite was estimated to be 0.16 millirem from atmospheric releases of radioactivity, and 0.17 millirem from liquid releases of radioactivity. There was one accidental release of tritium to air on February 7, when 100 curies were released from a K-Area stack. The maximum radiation dose offsite was calculated to be 0.003 millirem (mrem); SRS issued a detailed report on the impact of routine and accidental releases of tritium from 1964 to 1988 on the environment. Currently, SRS investigating possible causes for higher concentrations of mercury found in fish caught onsite, compared to those taken from the Savannah River. Mercury concentrations have been higher in onsite

fish since 1989; and, n response to concerns expressed by the Georgia Department of Natural Resources (GDNR) over concentrations of radionuclides in fish collected from the Savannah River, the Savannah River Site is working with the GDNR to resolve technical issues regarding sampling and analyses of fish from the river and the resultant dose calculations.

4215 (WSRC-MS–92-214) **Delineate subsurface structures with ground penetrating radar.** Wyatt, D.E. (Westinghouse Savannah River Co., Aiken, SC (United States)); Hu, L.Z.; Ramaswamy, M.; Sexton, B.G. Westinghouse Savannah River Co., Aiken, SC (United States). [1992]. 14p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC09-89SR18035. (CONF-9210171–1: Eastern regional groundwater issues conference, Boston, MA (United States), 13 Oct 1992). Order Number DE93000474. Source: OSTI; NTIS; INIS; GPO Dep.

High resolution ground penetrating radar (GPR) surveys were conducted at the Savannah River Site in South Carolina in late 1991 to demonstrate the radar techniques in imaging shallow utility and soil structures. Targets of interest at two selected sites, designated as H- and D-areas, were a buried backfilled trench, buried drums, geologic stratas, and water table. Multiple offset 2-D and single offset 3-D survey methods were used to acquire high resolution radar data. This digital data was processed using standard seismic processing software to enhance signal quality and improve resolution. Finally, using a graphics workstation, the 3D data was interpreted. In addition, a small 3D survey was acquired in The Woodlands, Texas, with very dense spatial sampling. This data set adequately demonstrated the potential of this technology in imaging subsurface features.

4216 (WSRC-RP–89-1199) **Groundwater quality assessment/corrective action feasibility plan: Savannah River Laboratory Seepage Basins.** Stejskal, G.F. Westinghouse Savannah River Co., Aiken, SC (United States). 15 Nov 1989. 317p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC09-89SR18035. Order Number DE93000787. Source: OSTI; NTIS; GPO Dep.

The Savannah River Laboratory (SRL) Seepage Basins are located in the northeastern section of the 700 Area at the Savannah River Site. Currently the four basins are out of service and are awaiting closure in accordance with the Consent Decree settled under Civil Act No. 1:85-2583. Groundwater monitoring data from the detection monitoring network around the SRL Basins was recently analyzed using South Carolina Hazardous Waste Management Regulations R.61-79.264.92 methods to determine if groundwater in the immediate vicinity of the SRL Basins had been impacted. Results from the data analysis indicate that the groundwater has been impacted by both volatile organic constituents (VOCs) and inorganic constituents. The VOCs, specifically trichloroethylene and tetrachloroethylene, are currently being addressed under the auspices of the SRS Hazardous Waste Permit Application (Volume III, Section J.6.3). The impacts resulting from elevated levels of inorganic constituent, such as barium, calcium, and zinc in the water table, do not pose a threat to human health and the environment. In order to determine if vertical migration of the inorganic constituents has occurred three detection monitoring wells are proposed for installation in the upper portion of the Congaree Aquifer.

4217 (WSRC-RP–92-250) **Cesium in the Savannah River Site environment.** Carlton, W.H.; Bauer, L.R.; Evans, A.G.; Geary, L.A.; Murphy, C.E. Jr.; Pinder, J.E.; Strom, R.N. Westinghouse Savannah River Co., Aiken, SC (United States). Mar 1992. 98p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC09-89SR18035. Order Number DE93000390. Source: OSTI; NTIS; INIS; GPO Dep.

Cesium in the Savannah River Site Environment is published as a part of the Radiological Assessment Program (RAP). It is the fourth in a series of eight documents on individual radioisotopes released to the environment as a result of Savannah River Site (SRS) operations. The earlier documents describe the environmental consequences of tritium, iodine, and uranium. Documents on plutonium, strontium, carbon, and technetium will be published in the future. These are dynamic documents and current plans call for revising and updating each one on a two-year schedule.Radiocesium exists in the environment as a result of above-ground nuclear weapons tests, the Chernobyl accident, the destruction of satellite Cosmos 954, small releases from reactors and reprocessing plants, and the operation of industrial, medical, and educational facilities. Radiocesium has been produced at SRS during the operation of five production reactors. Several hundred curies of ^{137}Cs was released into streams in the late 50s and 60s from leaking fuel elements. Smaller quantities were released from the fuel reprocessing operations. About 1400 Ci of ^{137}Cs was released to seepage basins where it was tightly bound by clay in the soil. A much smaller quantity, about four Ci. was released to the atmosphere. Radiocesium concentration and mechanisms for atmospheric, surface water, and groundwater have been extensively studied by Savannah River Technology Center (SRTC) and ecological mechanisms have been studied by Savannah River Ecology Laboratory (SREL). The overall radiological impact of SRS releases on the offsite maximum individual can be characterized by total doses of 033 mrem (atmospheric) and 60 mrem (liquid), compared with a dose of 12,960 mrem from non-SRS sources during the same period of time. Isotope ^{137}Cs releases have resulted in a negligible risk to the environment and the population it supports.

4218 (WSRC-RP–92-482) **Vegetation survey of Pen Branch and Four Mile Creek wetlands.** Westinghouse Savannah River Co., Aiken, SC (United States); Dames and Moore, Los Angeles, CA (United States). [1992]. 435p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC09-89SR18035. Order Number DE93000495. Source: OSTI; NTIS; GPO Dep.

One hundred-fifty plots were recently sampled (vegetational sampling study) at the Savannah River Site (SRS). An extensive characterization of the vascular flora, in four predetermined strata (overstory, Understory, shrub layer, and ground cover), was undertaken to determine dominance, co-dominance, and the importance value (I.V.) of each species. These results will be used by the Savannah River Laboratory (SRL) to evaluate the environmental status of Four Mile Creek, Pen Branch, and two upland pine stands. Objectives of this study were to: Describe in detail the plant communities previously mapped with reference to the topography and drainage, including species of plants present: Examine the successional trends within each sampling area and describe the extent to which current vegetation communities have resulted from specific earlier vegetation disturbances (e.g., logging and grazing); describe in detail the botanical field techniques used to sample the flora; describe the habitat and location of protected and/or rare species of plants; and collect and prepare plant species as herbarium quality specimens. Sampling was conducted at Four Mile Creek and Pen Branch, and in two upland pine plantations of different age growth.

4219 (YJT–92-04) **Diffusion in the rock matrix - a review of laboratory tests and field studies.** Valkiainen, M. (Technical Research Centre of Finland, Espoo (Finland). Reactor lab.). Voimayhtioeiden Ydinjaetetoimikunta, Helsinki (Finland). Apr 1992. 57p. Order Number DE93607108. Source: OSTI; NTIS; INIS.

The radionuclides released from an underground repository of radioactive waste quarried deep into bedrock, will be transported by groundwater along existing open fracture networks. Transport will be retarded by sorption and diffusion in the rock matrix. There has been quite a lot of research related to the matrix properties of various rock types and related theoretical aspects in the last decade. The report contains a brief review on the research work and results on the matrix diffusion in the rocks. The aim is to evaluate the evidence of matrix diffusion and to assess parameters related to the diffusion in rock. There are a lot of laboratory results on rock samples indicating that porosity as such seems to be continuous through granitic rocks even if the lithostatic pressure comparable to the repository depth is taken into account. On the other hand many of the observed alternated zones and concentration profiles observed in nature seem to have limited depth dimension. More evidence is needed to explain in which conditions porosity is open and which conditions closed. Anion exclusion is found to have an effect on matrix diffusion. When taken into account in the pore diffusion model, the porosity effectively decreases from the the value applicable for water. The exclusion effect is stronger in dilute solutions. The effective porosity for anions can be ten times smaller in dilute solutions, such as some groundwaters, compared to solutions of high salinity.

4220 (YJT–92-06) **Bedrock model of the Romuvaara area: Summary report.** Saksa, P. (ed.) (Saanio and Riekkola Consulting Engineers, Helsinki (Finland)); Ahokas, H.; Paananen, M.; Paulamaeki, S.; Anttila, P.; Pitkaenen, P.; Fr. Voimayhtioeiden Ydinjaetetoimikunta, Helsinki (Finland). May 1992. 129p. Order Number DE93607142. Source: OSTI; NTIS; INIS.

Site for the final disposal of the spent nuclear fuel investigations implemented in accordance with the research programme drawn up by Teollisuuden Voima Oy were carried out at Romuvaara, Kuhmo, in 1987 - 1991. Model of the site were compiled and used for describing the rock types, fractures, fracturing structures and geohydrological conditions, the main emphasis being on the examination of the bedrock fracturing and related hydraulic conductivity. Three-dimensional models were used for the classification of the various properties of the bedrock structures. The descriptive models were gathered together in a computerized system to facilitate illustration and strage. The rock types at Romuvaara are gneiss, mica gneiss, leucotonalite gneiss, amphibolite, granodiorite and metadiabase. The structural model for fracturing at the site contains 19 zones described in terms of a number of properties. The fracturing observed at Romuvaara ranges from local occurences of dence fracturing to significant, altered fracture zones. The structural model includes deduced values for hydraulic conductivity, deduced points of flow in the boreholes and measured hydraulic heads.Various classifications were used for assessment of hydraulic conductivity in the zones and solid bedrock, and in both cases conductivity was found to diminish with depth. Measured hydraulic heads were mostly found to support structural interpretation. The results were used for estimation of a three-dimensional hydraulic head distribution. Results from pumping tests carried out in the significant flow zone support the geometric interpretation.

4221 (YJT–92-07) **The Geology of the Kivetty area: Summary report.** Anttila, P. (ed.) (Imatran Voima Oy, Vantaa (Finland)); Paulamaeki, S.; Lindberg, A.; Paananen, M.; Koistinen, T.; Front, K.; Pitkaenen, P. Voimayhtioeiden Ydinjaetetoimikunta, Helsinki (Finland). May 1992. 74p. Order Number DE93607143. Source: OSTI; NTIS; INIS.

Teollisuuden Voima Oy (TVO) is preparing for the final disposal of spent nuclear fuel from the Olkiluoto nuclear power plant (TVO-I and TVO-II) deep in the Finnish bedrock. Kivetty in Konginkangas was one of the five areas selected in 1987 for preliminary site investigations for this purpose. The Kivetty area in Central Finland is located in a Svecokarelian granitoid environment consisting of a complex of synorogenic granitoids 1900 - 1860 million years in age. The bedrock consists almost entirely of plutonic rocks, i.e. gabbro, porphyritic granodiorite and granite, eguigranular granodiorite and granite, listed in order of age. The majority of the rock types are porphyritic in character, and supracrustal rocks such as quartz-feldspar schist and gneiss are found occasionally in small xenoliths.

4222 (YJT–92-10) **Creep in crystalline rock with application to high level nuclear waste repository.** Eloranta, P. (Helsinki Univ. of Technology, Espoo (Finland). Lab. of Rock Engineering); Simonen, A.; Johansson, E. Voimayhtioeiden Ydinjaetetoimikunta, Helsinki (Finland). Jun 1992. 47p. Order Number DE93607144. Source: OSTI; NTIS; INIS.

The time-dependent strength and deformation properties of hard crystalline rock are studied. Theoretical models defining the phenomena which can effect these properties are reviewed. The time-dependent deformation of the openings in the proposed nuclear waste repository is analysed. The most important factors affecting the subcritical crack growth in crystalline rock are the stress state, the chemical environment, temperature and microstructure of the rock. There are several theoretical models for the analysis of creep and cyclic fatigue: deformation diagrams, rheological models thermodynamic models, reaction rate models, stochastic models, damage models and time-dependent safety factor model. They are defective in describing the three-axial stress condition and strength criteria. In addition, the required parameters are often too difficult to determine with adequate accuracy. Therefore these models are seldom applied in practice. The effect of microcrack- driven creep on the stability of the work shaft, the emplacement tunnel and the capsulation hole of a proposed nuclear waste repository was studied using a numerical model developed by Atomic Energy of Canada Ltd. According to the model, the microcrack driven creep progresses very slowly in good quality rock. Poor rock quality may accelerate the creep rate. The model is very sensitive to the properties of the rock and secondary stress state. The results show that creep causes no stability problems on excavations in good rock. The results overestimate the effect of the creep, because the analysis omitted the effect of support structures and backfilling.

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Refer also to citation(s) 2618, 2619, 2766, 2778, 2780, 2781, 2782, 2783, 2784, 2816, 2820, 2832, 2834, 2835, 2836, 2837, 2905, 3028, 3084, 3085, 3086, 3087, 3097, 3466, 3469, 3535, 3536, 3537, 3538, 3539, 3756, 3816, 4112, 4140, 4154, 4157, 4158, 4167, 4168, 4178, 4179, 4187, 4197, 4198, 4206, 4207, 4211, 4212, 4214, 4361, 4363, 4383, 4425, 4426, 4428, 4785

4223 (BNL–47921) **Fast repetition rate (FRR) fluorometer for making in situ measurements of primary productivity.** Kolber, Z.S.; Falkowski, P.G. Brookhaven National Lab., Upton, NY (United States). [1992]. 6p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC02-76CH00016. (CONF-921066–1: Oceans '92, Newport, RI (United States), 26-29 Oct 1992). Order Number DE92041318. Source: OSTI; NTIS; GPO Dep.

Understanding the ocean carbon cycle and predicting how climate-induced changes in ocean circulation will affect ocean productivity requires that (a) primary productivity be measured with high spatial and temporal resolution, and (b) natural variability in primary productivity be parameterized with regardto environmental factors such as nutrient availabuity, irradiance, and temperature. Instrumentation to measure primary productivity from the stimulated in vivo fluoresence of phytoplankton chlorophyll is currendy being developed at Brookhaven National Laboratory. The instrumentation is based on fast repetition rate (FRR) fluorometry, and provides a robust technique for deriving the photosynthetic rates in situ. Moreover, the FRR methodology directly measures several photosynthetic parameters such as effective absorption cross- section, photo-conversion efficiency, and turnover time of photosynthesis, and relate them to primary productivity. Since photosynthetic parameters are affected by environmental factors such as fight and nutrient availability, the relationship between these parameters and primary productivity can be established. By understanding such relationships, prognostic models of primary productivity can be developed and parameterized.

4224 (BNWL-SA–4662) **^{55}Fe concentration and specific activities in north Pacific marine organisms.** Jenkins, C.E.; Langford, J.C. Battelle Pacific Northwest Lab., Richland, WA (United States). [1972]. 11p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE93001727. Source: OSTI; NTIS (US Sales Only); GPO Dep.

The ^{55}Fe from nuclear weapons testing which enters the ocean is in a chemical form which is much more readily available for biological uptake than is stable oceanic iron. This property of ^{55}Fe results in up to 1000-fold higher ^{55}Fe specific activities in marine organisms than is present in seawater. Dilution of ^{55}Fe by stable iron from anthropogenic sources or natural sources appears to be responsible for the lower specific activity in mid-latitude marine organisms than in organisms from high latitudes. The half-time for ^{55}Fe in harvested salmon from the west coast is essentially the same as the half-residence time for stratospheric radioactive debris. This fact suggests that ^{55}Fe reaching the ocean surface is available for biological uptake for a relatively short time. Measurements of ^{55}Fe specific activities in certain crustacea predacious fish than in the phytoplankton. What we have learned about the behavior of the radionuclide ^{55}Fe in the ocean environment may well apply to other fallout radionuclides, and a consideration of this fact should be included in estimating the potential hazard of the release of radionuclides to the marine environment. These data suggest that the release of radioiron from a reactor to the oceans at northern latitudes may have a 10 to 30-fold greater impact than releases of radioiron at mid-latitudes.

4225 (CONF-910550–, pp. 709-723) **Degradation of munition wastes by Phanerochaete chrysosporium.** Sublette, K.L. (Univ. of Tulsa, OK (United States)); Ganapathy, E.V.; Schwartz, S. National Renewable Energy Lab., Golden, CO (United States); Oak Ridge National Lab., TN (United States). 1992. From 13. symposium on biotechnology for fuels and chemicals; Colorado Springs, CO (United States); 6-10 May 1991. In *Thirteenth symposium on biotechnology for fuels and chemicals: Proceedings.* 846p. Source: The Humana Press, Inc., Totowa, NJ 07511 (United States).

'Pink water' is a waste-water stream generated by munitions LAP (loading, assembly, and packing) operations. The major components of this waste water are trinitrotoluene (TNT) and cyclotrimethylene trinitramine (RDX) at concentrations of 120-175 mg/L and 25 mg/L, respectively. Currently, pink water is treated by activated carbon adsorption. Removal efficiencies of > 99.5% have been reported. However, this treatment method suffers a serious limitation in that the carbon cannot be safely regenerated. Loaded carbon is disposed of by incineration after a single use. The authors have demonstrated that TNT, RDX, simulated, and actual pink water can be effectively treated by Phanerochaete chrysosporium immobilized on the disks of a rotating biological contractor (RBC) in both batch and continuous modes. Greater than 90% removal of TNT from a simulated pink water was observed in a continuous RBC with a residence time of about 24 h. The disk area required was about 10,000 ft^2/gpM (4091 m^2/m^3h) feed. RDX was amenable to treatment, but RDX removal rates were somewhat slower. A full-scale treatment system was designed on the basis of laboratory data, and a cost analysis was performed. This analysis has shown that biotreatment of pink water can be a cost-effective alternative to carbon adsorption.

4226 (CONF-910550–, pp. 777-788) **Sorption of heavy metals by untreated red fir sawdust.** Bryant, P.S. (Washington State Univ., Pullman (United States)); Petersen, J.N.; Lee, J.M.; Brouns, T.M. National Renewable Energy Lab., Golden, CO (United States); Oak Ridge National Lab., TN (United States). 1992. From 13. symposium on biotechnology for fuels and chemicals; Colorado Springs, CO (United States); 6-10 May 1991. In *Thirteenth symposium on biotechnology for fuels and chemicals: Proceedings.* 846p. Source: The Humana Press, Inc., Totowa, NJ 07511 (United States).

Equilibrium and rate relationships have been determined for the sorption of divalent copper (Cu^{2+}) and hexavalent chromium (Cr^{6+}) onto untreated Red Fir sawdust. For both ions, the equilibrium sorption levels were determined to be a function of the solution pH and temperature. The equilibrium adsorption capacity of the sawdust for Cu^{2+} was found to increase with increasing pH. However, for Cr^{6+} the sorption capacity increased with decreasing pH. For both ions, the rate of adsorption and the equilibrium adsorption capacity increased with temperature. The sorption capacity of α-cellulose was at least an order of magnitude less than the untreated sawdust.

4227 (CONF-910550–, pp. 801-809) **Acidogenic mine tailings: The use of biofilm bacteria to exclude oxygen.** Blenkinsopp, S.A. (Univ. of Calgary, Alberta (Canada)); Herman, D.C.; Costerton, J.W.; McCready, R.G.L. National Renewable Energy Lab., Golden, CO (United States); Oak Ridge National Lab., TN (United States). 1992. From 13. symposium on biotechnology for fuels and chemicals; Colorado Springs, CO (United States); 6-10 May 1991. In *Thirteenth symposium on biotechnology for fuels and chemicals: Proceedings.* 846p. Source: The Humana Press, Inc., Totowa, NJ 07511 (United States).

Acid mind drainage (AMD) is an important contributor to the deterioration of surface and ground water quality via acidification, heavy metal pollution, and sedimentation. The National Stream Survey (NSS) conducted by the US Environmental Protection Agency found that approx 4590 km of streams in the mid-Atlantic and southeastern United States were acidic because of AMD and 5780 km were strongly impacted, although not acidic. AMD is the product of reactions between sulfide-containing mine tailings, air, and water, as demonstrated in the following equations: FeS_2 (S) + $7/2O_2 + H_2O = Fe^{2+} + 2SO_4^{2-} + 2H^+$ (1) $Fe^{2+} + 1/4O_2 + H^+ = Fe^{3+} + 1/2H_2O$ (2) $Fe^{3+} + 3H_2O = Fe(OH)_3$ (S) + $3H^+$ (3) FeS_2 (S) + $14Fe^{3+} + 8H_2O = 15\ Fe^{2+} + 2SO_4^{2-} + 16H^+$ (4). The rate of oxygen penetration into the surface pore spaces of tailings is believed to control the rate of acid generation. It is therefore critical to reduce the rate of oxygen penetration or eliminate it completely. Pyrite will remain in a reduced state if the tailings environment can be kept anaerobic. It is well known that bacterial and plant growth in the surface layers of soil can completely consume the available oxygen, causing the remainder of the soil profile to exist in an anaerobic state. It has also been well demonstrated that bacteria are very capable of reducing the permeability of rock matrices through cell growth and exopolymer production. Based on these principles, mine-tailings columns were 'top-dressed' in the laboratory with bacteria and nutrients to determine whether an oxygen-excluding surface layer could be established to prevent the development of AMD. This article presents the preliminary data.

4228 (CONF-9109358–, pp. 28) **An early example of pollution prevention: The case of the Polish metal finishing and coating industry.** Jackson, G.S. (US Agency for International Development (United States)). USDOE, Washington, DC (United States). [1991]. From 8. international conference on chemistry for protection of the environment; Lublin (Poland); 16-18 Sep 1991. In *Chemistry for protection of the environment, Eight international conference: Proceedings.* 635p. Order Number DE92014317. Source: OSTI; NTIS; INIS.

An early attempt at imparting the Principles of Pollution Prevention took place in Poland on a project supported by the United Nations Industrial Development Organization (UNIDO) designed to reduce toxic metal pollutants from the metal finishing industry. Several plants were visited and a demonstration program was suggested at the Warsaw Fiat Automobile manufacturing plant (FSO). This demonstration program was offered to incorporate low cost in plant design changes, using existing equipment to reduce wastes and water consumption, such as countercurrent rinsing and fog rinsing, proper racking of work pieces and careful attention to toxics reduction and material recovery and substitution. The Polish ministry responsible for this task was the Institute of Mechanical Precision (IMP) in Warsaw. The program was estimated to save over $2 Million /yr and have a payoff time of less than six months. The program was never fully implemented, despite assurances from the highest levels of IMP and FSO including UNIDO sponsored training and research. The lesson to be drawn from this episode is clear: the 'hard' or technical side of pollution prevention, while important, is not sufficient with a strong commitment from the 'soft' or management side of the equation. The future looks promising if developing countries and their sponsoring AID agencies can heed these warnings.

4229 (CONF-9109358–, pp. 15) **Evaluation of non-point sources of surface water contamination.** Bradford, W.L. (Versar, Inc., Springfield, VA (United States)); Richards, J.N. USDOE, Washington, DC (United States). [1991]. From 8. international conference on chemistry for protection of the environment; Lublin (Poland); 16-18 Sep 1991. In *Chemistry for protection of the environment, Eight international conference: Proceedings.* 635p. Order Number DE92014317. Source: OSTI; NTIS; INIS.

A study of constituent concentrations and loadings to surface waters from various nonurban land-use areas was conducted over a 2 1/2-year period in the Monocacy River Basin, a drainage area of approximately 970 square miles (2512 km^2), in central Maryland, USA. The study focused on nutrients (nitrogen and phosphorus species), total suspended solids, and total and fecal coliforms, and examined statistically the concentrations and loadings in baseflow and stormflow as a function of land use, season, storm intensity, and farming practices. The results formed the baseline for evaluation of the effectiveness of future implementation of best management practices on farms to reduce nutrient and suspended solids loading to the Monocacy River and the Potomac River, and to reduce coliform loadings in local streams. The results of extensive statistical hypothesis testing on the data base using various parametric and non-parametric procedures showed patterns inconstituent concentrations and loadings between watersheds with the highest concentrations and loadings occurring in watersheds with 70% or more of the area devoted to farming, and from individual types of farms.

4230 (CONF-9109358–, pp. 18) **Anion exchange removal of cadmium-EDTA complexes.** Dedzinska, M.R. (Water and Wastewater Department Technical University of Lublin (Poland)); Pawlowski, L. USDOE, Washington, DC (United States). [1991]. From 8. international conference on chemistry for protection of the environment; Lublin (Poland); 16-18 Sep 1991. In *Chemistry for protection of the environment, Eight international conference: Proceedings.* 635p. Order Number DE92014317. Source: OSTI; NTIS; INIS.

Because of ionic character of metal species in water solutions, ion exchange has been in the center of research attention as basic for metal removal processes. In natural water systems as well as in human created wastes there are more and more organic substances capable of acting as ligands for cation species, so the possibility of heavy metals existing in the simple cationic forms seems to be minimal. Among the organics capable of complexing metals are natural substances like humic and fulvic acids as well as manmade chelating agents like commonly used replacements of tripolyphosphate in household detergents - NTA and EDTA. EDTA is considered to be resistant to biodegradation, growing concentrations of EDTA in water streams lead to increased levels of trace metals in effluents from traditional treatment plants and may cause unexpected problems for humans.

4231 (CONF-9109358–, pp. 5) **Ozonation process with heterogeneous catalyst in barbotage column system.** Tosik, R. (Technical University of Lodz (Poland)); Wiktotowski, S. USDOE, Washington, DC (United States). [1991]. From 8. international conference on chemistry for protection of the environment; Lublin (Poland); 16-18 Sep 1991. In *Chemistry for protection of the environment, Eight international conference: Proceedings.* 635p. Order Number DE92014317. Source: OSTI; NTIS; INIS.

Application of ozone for wastewaters purification depends on its utilization degree. It was stated that favorable ozone utilization degree conditions were in two joint reactors systems. Fine and great dispersion reactors were used in the two stage ozonation process for Direct Blue 84 solution decolorization. The catalyst was used in the great dispersion reactor as a fluidized phase.

4232 (CONF-9109358–, pp. 10) **Determination of harmful substances in the Liwiec river in Poland.** Jaroszylnska, J. (Agricultural and Teachers University, Siedlce (Poland)); Oprzadek, K.; Zalewski, W. USDOE, Washington, DC (United States). [1991]. From 8. international conference on chemistry for protection of the environment; Lublin (Poland); 16-18 Sep 1991. In *Chemistry for protection of the environment, Eight international conference: Proceedings.* 635p. Order Number DE92014317. Source: OSTI; NTIS; INIS.

The Liwiec river is 130 kms long. It is an affluent of the Bug river. The river wells in marshes and quagmires that are localized in the east of Siedlcd. It flows across typical agricultural areas far from towns. There are two places where communal sewers pollute the water of the Liwiec river (at the 31st and the 80th km of the river section). From January to May 1991 water in the Liwiec river was investigated at the 19th to 47th km river section. The samples were always taken in the same places in the vicinity of following villages: Wyczolki, Pruxzynek, Golice, Perzec, Chodow, Kisielany, Mokobody. The concentration of heavy metals (Fe, Mn, Zn, Cu, Ni, Co, Pb, Cd), chlorides, nitrates, nitrites, dissolved oxygen, biochemical oxygen demand (after five days), dissolved compounds and pH were analyzed. The results of the analysis are presented. The curves present an arithmetic mean results of the chemical analysis. The values of the admissible pollutants concentration for the three classes of the water purity in Poland and the obtained results of the chemical analysis of the Liwiec water are given. The obtained data helped to determine the purity of the Liwiec river as the second or third purity class.

4233 (CONF-9109358–, pp. 20) **The use of ion exchangers for the recovery of nickel from washery effluents after the process of nickel plating.** Jozwiak, A. (Technical University of Lodz (Poland)); Gorzka, Z. USDOE, Washington, DC (United States). [1991]. From 8. international conference on chemistry for protection of the environment; Lublin (Poland); 16-18 Sep 1991. In *Chemistry for protection of the environment, Eight international conference: Proceedings.* 635p. Order Number DE92014317. Source: OSTI; NTIS; INIS.

The results of equilibrium and dynamic investigations and the knowledge of the kinetics of the H^+/Ni^{2+} exchange for both the ion exchangers are decisive of the possibility of using the ion exchangers Wofatit KS-10 and Wofatit KPS for the removal of nickel ions form washery effluents. As effect of temperature on the rate of the H^+/Ni^{2+} exchange over the range of 293-313 K, of the acidity of the solution form 0 to 1.0 mole/dm^3 of HCL and of the initial concentration of Ni/II/over the range of 0.05-0.7 mole/dm^3 have been studied. The state of equilibrium was attained in all the experiments in the time of 2 hours. It has been found that the concentration of hydrochloric acid contained in the solution over the concentration range investigated does not affect the kinetics of the H^+/Ni^{2+} exchange but it has an effect on the equilibrium of the exchange. Basing on the investigations carried out it can be supposed the internal diffusion, that is transport of Ni/II/ions inside the ion exchanger is decisive of the rate of the H^+/Ni^{2+} exchange process under the conditions used in the experiments made both for Wofatit KS-10 and Wofatit KPS. Investigation was aimed at determination of the effect of the hydraulic load and the counterion effect on it. Over the range of loads of 4.3 - 16.8 m^3/m^{3}h no changes in the course of the H^+/Ni^{2+} exchange process were observed.

4234 (CONF-9206301–1) **Individual-based modeling of environmental quality effects on early life stages of fish: A case study using striped bass.** Rose, K.A. (Oak Ridge National Lab., TN (United States)); Cowan, J.H. Jr.; Houde, E.D.; Coutant, C.C. Oak Ridge National Lab., TN (United States). [1992]. 47p. Sponsored by Electric Power Research Inst., Palo Alto, CA (United States). DOE Contract AC05-84OR21400. From 16. annual larval fish conference; Kingston, RI (United States); 16-19 Jun 1992. Order Number DE93001365. Source: OSTI; NTIS; GPO Dep.

We demonstrate an individual-based approach to population modeling to evaluate environmental quality effects on early life stages of fishes. We believe that, regardless of the modeling approach, environmental quality effects ultimately must be evaluated at the population level. Determining population-level consequences of changes in environmental quality is critical because the population is the relevant endpoint of interest with respect to success of the species and its availability for harvest. It offers a common metric upon which to compare among different environmental factors, effects, and life stages.

4235 (DOE/ER/30196–2) **[Incorporation of an organic MAGIC (Model of Acidification of Groundwater in Catchments) and testing of the revised model using independent data sources]: Progress report, March 16, 1992–September 15, 1992.** Sullivan, T.J. E and S Environmental Chemistry, Inc., Corvallis, OR (United States). Sep 1992. 82p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG02-92ER30196. Order Number DE93000543. Source: OSTI; NTIS; GPO Dep.

A project was initiated in March, 1992 to (1) incorporate a rigorous organic acid representation, based on empirical data and geochemical considerations, into the MAGIC model of acidification response, and (2) test the revised model using three sets of independent data. After six months of performance, the project is on schedule and the majority of the tasks outlined for Year 1 have been successfully completed. Major accomplishments to data include development of the organic acid modeling approach, using data from the Adirondack Lakes Survey Corporation (ALSC), and coupling the organic acid model with MAGIC for chemical hindcast comparisons. The incorporation of an organic acid representation into MAGIC can account for much of the discrepancy earlier observed between MAGIC hindcasts and paleolimnological reconstructions of preindustrial pH and alkalinity for 33 statistically-selected Adirondack lakes. Additional work is on-going for model calibration and testing with data from two whole-catchment artificial acidification projects. Results obtained thus far are being prepared as manuscripts for submission to the peer-reviewed scientific literature.

4236 (DOE/ER/61019–3) **Thermohaline circulations and global climate change: Annual progress report no. 3, January 15, 1992–December 14, 1992.** Hanson, H.P. Colorado Univ., Boulder, CO (United States). Cooperative Inst. for Research in

Environmental Sciences. [1992]. 6p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG02-90ER61019. Order Number DE93004601. Source: OSTI; NTIS; GPO Dep.

This report discusses research activities conducted during the period 15 January 1992–14 December 1992. Thermohaline Circulations and Global Climate Change is concerned with investigating the hypothesis that changes in surface thermal and hydrological forcing of the North Atlantic, changes that might be expected to accompany $C0_2$-induced global warming, could result in ocean-atmosphere interactions' exerting a positive feedback on the climate system. Because the North Atlantic is the source of much of the global ocean's reservoir of deep water, and because this deep water could sequester large amounts of anthropogenically produced $C0_2$, changes in the rate of deep-water production are important to future climates. Since deep-water Production is controlled, in part, by the annual cycle of the atmospheric forcing of the North Atlantic, and since this forcing depends strongly on both hydrological and thermal processes as well as the windstress, there is the potential for feedback between the relatively short-term response of the atmosphere to changing radiative forcing and the longer-term processes in the oceans. Work over the past 11 months has proceeded according to the continuation discussion of last January and several new results have arisen.

4237 (DOE/ID/13042–T4) **Supplemental investigations in support of environmental assessments by the Idaho INEL Oversight Program at the Idaho National Engineering Laboratory: Status report, June 30, 1992.** Idaho Dept. of Health and Welfare, Boise, ID (United States). 1992. 5p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FC07-91ID13042. Order Number DE93003254. Source: OSTI; NTIS; INIS; GPO Dep.

This document reports on the status of supplemental investigations in support of environmental assessments by the Idaho INEL Oversight Program at the Idaho National Engineering Laboratory. Included is information on hydrology studies in wells open through large intervals, unsaturated zone contamination and transport processes, surface water-groundwater interactions, regional groundwater flow, and independent testing of air quality data.

4238 (DOE/PN/38014–T1) **1991 environmental monitoring report for the Naval Reactors Facility.** Westinghouse Electric Corp., Idaho Falls, ID (United States). [1991]. 43p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC11-89PN38014. (NRFRC-EC–1007). Order Number DE93000382. Source: OSTI; NTIS; INIS; GPO Dep.

The results of the radiological and non-radiological environmental monitoring programs for 1991 at the Naval Reactors Facility (NRF) are presented in this report. The results obtained from the environmental monitoring programs verify that releases to the environment from operations at NRF were within the guidelines established by state and federal regulations. Evaluation of the environmental data confirms that the operation of NRF continues to have no adverse effect on the quality of the environment or heath and safety of the general public. Furthermore, a conservative assessment of radiation exposure to the general public as a result of NRF operations demonstrated that the dose received by any member of the public was well below the most restrictive dose limits prescribed by the EnVironmental Protection Agency (EPA) and the Department of Energy (DOE).

4239 (ETDE-IT–92-85) **Gas exchange at air-sea interface: Technique for radon measurements in seawater.** Queirazza, G.; Roveri, M.; Delfanti, R.; Papucci, C. Ente Nazionale per l'Energia Elettrica, Milan (Italy). Centro Termica e Nucleare; ENEA, La Spezia (Italy). Centro Ricerche Energia Ambiente Santa Teresa. 1991. 13p. (CONF-9109443–1: International symposium on radionuclides in the study of marine processes (Radstomp 91), Norwich (United Kingdom), 9-14 Sep 1991). Order Number DE93729477. Source: OSTI; NTIS (US Sales Only); INIS.

The rate of exchange of various gas species, such as O_2, CO_2 etc. across the air-water interface can be evaluated from the ^{222}Rn vertical profiles in the water column. Radon profiles were measured in 4 stations in the NW Adriatic Sea, in September 1990, using solvent extraction and liquid scintillation counting techniques, directly on board the ship. The radiochemical procedure is described in detail. The lower limit of detection is approximately 0.4 mBq l^{-1}. The radon deficiency in the profiles gives estimates of the gas transfer rate across the air-sea interface ranging from 0.9 to 7.0 m d^{-1}. The suitability of the radon deficiency method in shallow water enclosed seas is briefly discussed.

4240 (ETDE-mf–93728811) **Toxicological assessment and screening method for groundwater contaminated by landfill leachates or other long-standing pollution.** WaBoLu-Hefte. Kaiser, U. Bundesgesundheitsamt, Berlin (Germany). Inst. fuer Wasser-, Boden- und Lufthygiene; Bundesministerium fuer Forschung und Technologie, Bonn (Germany). Jan 1992 72p. (In German). Contract BMFT 1440464-3. Order Number DE93728811. Source: OSTI; NTIS (US Sales Only).

This model was specifically developed for an assessment of the toxicological potential of possible oral exposures through drinking water taken from contaminated ground water. Special emphasis was placed on the problem of important information which may be lacking for individual toxicological fields. Any solutions suggested to-date to help this situation have fallen short. This new approach involves an assessment screening method which does not only cover the qualitative and quantitative aspects of the toxicity of a substance/compound, but also constitutes an attempt at making those substances comparable for a study even if they are differing in their data starting bases or if toxicological information is lacking in part. However, this standardized collection and assessment of groundwater contaminants from let-up industrial sites and landfills could not take the ecotoxicological potential into account. (orig.) With 15 figs.

4241 (ETDE-mf–93728815) **Treatment of effluent from dredged material disposal sites. Nitrification plant Francop. Final report.** Ergebnisse aus dem Baggergutuntersuchungsprogramm. Netzband, A. Freie und Hansestadt Hamburg (Germany). Strom- und Hafenbau; Umweltbundesamt, Berlin (Germany). Mar 1992 120p. (In German). Contract UBA 20 441-11/2. Order Number DE93728815. Source: OSTI; NTIS (US Sales Only).

Short Communication.

4242 (INIS-BR–2965) **Pre-concentration of Cr, Mn, Fe and Co of water sea and analysis by plasma emission spectroscopy - DCP.** Ferreira, E.M.M. Universidade do Estado, Rio de Janeiro, RJ (Brazil). Centro Biomedico. 1985 98p. (In Portuguese). Order Number DE93607151. Source: OSTI; NTIS (US Sales Only); INIS.

Studies of separation and pre-concentration methods of chromium, manganese, iron and cobalt from seawater, that allow use control methods of ^{51}Cr, ^{54}Mn, $^{55,59}Fe$, $^{58,59}Co$ with a better sensibility and the determination of this elements by atomic absorption spectroscopy or plasma emission spectroscopy are described. This methods of seawater analysis will use near the region of Angra I reactor. (author).

4243 (INIS-BR–3015) **Estimative of alpha radiation dose due to natural concentration of Ra-226 in waters from Pocos de Caldas.** Sigaud, G.M. Pontificia Univ. Catolica do Rio de Janeiro, RJ (Brazil). Dept. de Fisica. 1979 150p. (In Portuguese). Order Number DE93607152. Source: OSTI; NTIS (US Sales Only); INIS.

A dosimetric model for calculating the annual dose equivalent for an individual and the annual collective dose equivalent from ^{226}Ra is developed. This model is applied to the measured concentrations of ^{226}Ra in waters of the hydro graphic basins of the Pocos de Caldas plateau, using the pathways of drinking water and ingestion of food grown in irrigated fields. A linear model for simulating potential ^{226}Ra contamination of the waters of the region is also applied, and the doses from these contaminations are estimated using the dosimetric model developed. (author).

4244 (INIS-BR–3039) **Hydrogeologic, hydrogeochemical and isotopic studies of mineral and thermal waters from Aguas de Lindoia and Lindoia, SP.** Yoshinaga, S. Sao Paulo Univ., SP (Brazil). Inst. de Geociencias. 1990 134p. (In Portuguese). Order Number DE93607149. Source: OSTI; NTIS (US Sales Only); INIS.

The underground circulation of the so-called mineral waters of Aguas de Lindoia and Lindoia is conditioned by fractures of Complex Amparo crystalline rocks. The geologic studies and its evolutionary history are so important for understanding the origin, circulation and mineralization of these explored waters. The chemical analysis of the waters both from springs and wells pointed to low mineralization with about 100 mg/l TDS. The bi carbonated calcic and calcic-magnesian content was interpreted as coming from alteration processes of silicate minerals. The isotopes $\delta^{18}O$ and $\delta^{2}H$ concentrations indicate the meteoric origin, different recharge zones and evaporation phenomena in the springs and wells waters on the study area. The Radon-222 radioactivity used to classification of mineral waters in this legislation is dubious because it is unstable (3,82 days) and may be dangerous to human. (author).

4245 (INIS-mf–13375, pp. 35) **Distribution of radium in water and sediments of Rolston Creek and Reservoir. Application of direct deemenation method of analysis.** Essed, A.M.; Edwards, K.W. Tajoura Nuclear Research Centre, Tripoli (Libyan Arab Jamahiriya). 1984. 82p. (CONF-8409421–: Seminar on the use of research reactors in fundamental and applied sciences, Tajoura (Libyan Arab Jamahiriya), 16 Sep 1984). In *Seminar on the use of research reactors in fundamental and applied sciences. Programme and abstracts.* Order Number DE93606515. Source: Also available from Tajoura Nuclear Research Centre, Tajoura/Tripoli, Libya.

Short communication. RIVERS/radium 226; SEDIMENTS/radium 226; COLORADO; QUANTITY RATIO; RADIOACTIVITY; RIVERS; SEDIMENTS

4246 (KFK–4976, pp. 15-26) **Kinetic studies on metal interactions between water and clay minerals.** Donnert, D. (Kernforschungszentrum Karlsruhe GmbH (Germany). Abt. Wassertechnologie); Horst, J.; Eberle, S.H. Kernforschungszentrum Karlsruhe GmbH (Germany). Inst. fuer Nukleare Entsorgungstechnik. Dec 1991. (In German). (CONF-9009516–: Workshop on geochemical modeling, Karlsruhe (Germany), 19-20 Sep 1990). In *Geochemical modeling. Proceedings.* 107p. Order Number DE93705610. Source: OSTI; NTIS (US Sales Only).

Studies were performed with the aim of establishing the kinetic parameters basic to the interactions of heavy metals with koalinite under river conditions with and without addition of nitrilotriacetic acid (NTA). For this purpose laboratory experiments were performed with copper and zink and a model concept allowing mathematical predictions on the time course of heavy metal remobilization in sediment material was developed. (orig.).

4247 (KFK–4976, pp. 27-36) **Species distribution models and complexing on natural organic macromolecules.** Falck, W.E. (British Geological Survey, Nottingham (United Kingdom). Fluid Processes Research Group). Kernforschungszentrum Karlsruhe GmbH (Germany). Inst. fuer Nukleare Entsorgungstechnik. Dec 1991. (In German). (CONF-9009516–: Workshop on geochemical modeling, Karlsruhe (Germany), 19-20 Sep 1990). In *Geochemical modeling. Proceedings.* 107p. Order Number DE93705610. Source: OSTI; NTIS (US Sales Only).

The necessity of taking the influence of organic macromolecules on the speciation of ions in natural waters into account is continually gaining significance. Simple models with discrete ligands are not able to adequately simulate the heterogenity of binding sites and the dependence of bond force on quantities such as ionic strength. Therefore a more realistic model has been incorporated into the speciation programme PHREEQE. This model principally still works with discrete ligands so as to remain compatible with the PHREEQE concept, yet it also takes the influnece of electrostatic interactions on bond force into account. Two alternative formulations are presented, allowing for a plane and a spherical conformation of the macromolecules. The model is tried on data from literature. (orig.).

4248 (KFK–4976, pp. 37-50) **A vector-computer-oriented method for a combined calculation of geochemical and mass transport processes in aquifers.** Vogt, M. (Lahmeyer International GmbH, Frankfurt am Main (Germany)). Kernforschungszentrum Karlsruhe GmbH (Germany). Inst. fuer Nukleare Entsorgungstechnik. Dec 1991. (In German). (CONF-9009516–: Workshop on geochemical modeling, Karlsruhe (Germany), 19-20 Sep 1990). In *Geochemical modeling. Proceedings.* 107p. Order Number DE93705610. Source: OSTI; NTIS (US Sales Only).

This paper presents a vectorcomputer-orientated multicomponent transport-reaction model. The features of the model are as follows: due to the optimization and vectorization of the computer code the model can be used even for large-scale simulations of coupled chemical and transport processes within a reasonable CPU-timescale. The model is very flexible in its ability to simulate any kind of chemical reaction. To demonstrate these features the model is applied to a case study of a two-dimensional transport process, combined with the interaction of cation exchange and calcite equilibrium mechanisms. (orig.).

4249 (KFK–4976, pp. 51-62) **Development of a simulation model for coupling microbial transformations and chemical equilibrium reactions.** Lensing, H.J. (Karlsruhe Univ. (Germany). Inst. fuer Hydromechanik); Herrling, B. Kernforschungszentrum Karlsruhe GmbH (Germany). Inst. fuer Nukleare Entsorgungstechnik. Dec 1991. (In German). (CONF-9009516–: Workshop on geochemical modeling, Karlsruhe (Germany), 19-20 Sep 1990). In *Geochemical modeling. Proceedings.* 107p. Order Number DE93705610. Source: OSTI; NTIS (US Sales Only).

Under certain conditions the transformations effected by individual bacteria groups exert considerable influence on the chemical medium in the aquifer. Besides the enzyme kinetics, which can by approximation be determined with monod kinetics, the kinetics of the diffusive exchange between mobile interstitial water and the immobile biophase is decisive in simulating these changes. The two-zone approach permits a representation of the partly parallel reduction of the individual electron acceptors. The model also dispends with unprovable suppositions on the distribution of biomass on a microscopic scale. The macroscopic variable of bacteria concentration in the biofilm contains all the information on the distribution of biomass in the system and can under certain circumstances be measured in practice. The kinetics of the diffusion exchange between the phases in the system cannot be measured directly, but this problem is common to all models based on kinetics. (orig.).

4250 (KFK–4976, pp. 89-98) **How strong are the interactions of the main components on the calculated activity of the minor and trace components in natural waters? - A case study with Pitzer's model BrinEQ.** Kahlert, H. (Sediment-Petrographisches Inst., Goettingen (Germany)). Kernforschungszentrum Karlsruhe GmbH (Germany). Inst. fuer Nukleare Entsorgungstechnik. Dec 1991. (In German). (CONF-9009516–: Workshop on geochemical modeling, Karlsruhe (Germany), 19-20 Sep 1990). In *Geochemical modeling. Proceedings.* 107p. Order Number DE93705610. Source: OSTI; NTIS (US Sales Only).

The aim of this work is to present with the assistance of Pitzer's theory a semi-quantitative model permitting an estimation of the reactivity ('activity') of minor and trace components solely on the basis of the amount and type of their charge. A further intention is to demonstrate that the main components have a strong influence on the solution behaviour of the trace and minor components (matrix effects) whereas the trace elements cause no significant change in the activity of the main components of the solution. The results calculated for two 'typical' waters ('river, sea water test case') are presented as input parameters. They can be considered representative for natural conditions and are also accepted as an 'international standard' in literature. (orig.).

4251 (ORNL/M–2380) **Clinch River Environmental Restoration Program: Phase 1, Data listing.** Cook, R.B. Oak Ridge National Lab., TN (United States). 28 Sep 1992. 275p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. Order Number DE93001401. Source: OSTI; NTIS; INIS; GPO Dep.

This report consists of tables and listings from the results of the Phase I data gathering activities of the Clinch River Environmental Restoration Program (CR-ERP). The table of contents outlines the presentation of the material and has been annotated to indicate the key fields used to order the printing of each data table. Definitions of selected column headings are provided. Sample collection information is shown first and then more specific information for each matrix type is presented. The analytical results have been reviewed

by independent validators and the qualifiers shown are the results of their efforts. No data that were rejected by the validation process are included in this listing. Only results of routine samples are listed; quality control sample results were excluded. All data, both detected and nondetected values, were used to calculated the summary table values. However, only Detected values are given on the analyte specific listings.

4252 (PNL-SA–21163) **Internal gravity waves in the equatorial Pacific.** Skyllingstad, E.D. (Battelle/Marine Sciences Lab., Sequim, WA (United States)); Denbo, D.W. Pacific Northwest Lab., Richland, WA (United States). Sep 1992. 6p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. (CONF-9209158–6: 10. symposium on turbulence and diffusion, Portland, OR (United States), 29 Sep - 2 oct 1992). Order Number DE93001517. Source: OSTI; NTIS; GPO Dep.

Mixing in the ocean surface layer is an important process in the transport of heat, momentum, and CO_2 into the deep ocean, For example, the flux of heat into the cold, upwelling water in equatorial regions provides one of the major heat sources driving the ocean circulation. Direct measurements of the ocean mixed layer have provided good estimates of the bulk layer properties. However, estimates of the small-scale effects of intenial waves and related turbulence have remained ambiguous because of the difficulty in observing these processes. Until more detailed measurements become available, numerical models can provide a convenient and cost-effective way to analyze the details of the surface mixed layer. Modeling the surface layer of the equatorial Pacific Ocean is challenging because of the strong vertical current shear and density stratification common to the region. The primary zonal current is the eastward flowing Equatorial Undercurrent (EUC) centered at roughly 120 m depth, with a speed of about 1.5 ms^{-1} as shown in Figure 1. The EUC is forced by a zonal pressure gradient resulting from the westward directed surface wind stress. Above the EUC, the wind stress directly forces thee South Equatorial Current (SEC), which flows westward with a speed of about 0.5 ms^{-1}. The shear zone generated by these currents is marginally stable and exhibits a diurnal cycle of turbulence dependent on convection forced by surface cooling. In addition, surface convection forces internal gravity waves, which can transport momentum away from the surface current to deeper waters. In this report, we discuss recent modeling results for the equatorial Pacific showing the generation of convection, turbulence, and internal waves.

4253 (VTT-SYMP–126, pp. 45-52) **Modelling of coupled transport of air, water and heat in unsaturated zone.** Niemi, A. (Technical Research Centre of Finland, Espoo (Finland). Road and Traffic Lab.); Jaakkola, T. Technical Research Centre of Finland, Espoo (Finland). 1991. (In Finnish). (CONF-9105387–: Seminar on ground water modelling, Espoo (Finland), 9 May 1991). In *Ground water modelling.* 156p. Order Number DE93607107. Source: OSTI; NTIS; INIS.

In the article modelling of coupled transport of air, water and heat in gas and liquid phases is discussed. The numerical algorithm TOUGH used for the modelling as well as the application of the model to two case studies are described. In the first application the advancement of gas injected into fractured, water saturated rock is modelled. The second application concerns the modelling of a field experiment where the unsaturated zone in an esker formation is used for storage of heat. In the method warm air is injected into the unsaturated zone and transport of heat takes place both by convection of the air and conduction.

4254 (VTT-SYMP–126, pp. 53-74) **Modelling of soil porosity distributions and permeability: a new method.** Korkealaakso, J. (Technical Research Centre of Finland, Espoo (Finland). Road and Traffic Lab.); Jaakkola, T.; Hassinen, P. Technical Research Centre of Finland, Espoo (Finland). 1991. (In Finnish). (CONF-9105387–: Seminar on ground water modelling, Espoo (Finland), 9 May 1991). In *Ground water modelling.* 156p. Order Number DE93607107. Source: OSTI; NTIS; INIS.

Hydrologists are increasingly focusing on environmental problems. As these are mostly related to the shallow parts of the subsoil, there is a growing need for cost-effective advanced imaging techniques to map subsurface electrical conductivity variations. In the paper, a geoelectrical workstation (a device and software) for imaging is presented. A microcomputer-controlled device for automatic array (any electrode configuration) scanning using multi-electrode cables and time monitor is linked directly to control software and inversion programs. The continuous vertical soundings are automatically inverted using equivalent- multilayer-distribution procedure in which the number of layers equals the number of digitized points on the sounding curve. Resulting 2D-image is used together with additional geoinformation as a starting model for an iterative least squares procedure with singular value decomposition. Images can be used to locate and map lateral and vertical porosity variations in soil and rock, identify subsurface fractures and permeable zones, detect and map subsurface resistivity contrasts which may reflect the distribution of contaminants in the unsaturated and saturated zones and time monitor conductive tracers.

4255 (VTT-SYMP–126, pp. 81-99) **Inverse fracture network modelling.** Korkealaakso, J. (Technical Research Centre of Finland, Espoo (Finland). Road and Traffic Lab.); Niemi, A. Technical Research Centre of Finland, Espoo (Finland). 1991. (In Finnish). (CONF-9105387–: Seminar on ground water modelling, Espoo (Finland), 9 May 1991). In *Ground water modelling.* 156p. Order Number DE93607107. Source: OSTI; NTIS; INIS.

The basic problem in analyzing flow and transport in fractured rock is that the flow may be largely governed by a poorly connected network of fractures. Flow in such a system cannot be modeled with traditional modelling techniques. Fracture network models also have a limitation, in that they are based on geological data on fracture geometry even though it is known that only a small portion of fractures observed is hydraulically active. This paper discusses a new technique developed for treating the problem as well as presents a modelling example carried out to apply it. The approach is developed in Lawrence Berkeley Laboratory and it treats the fracture zone as an 'equivalent discontinuum'. The discontinuous nature of the problem is represented through flow on a partially filled lattice. An equivalent discontinuum model is constructed by adding and removing conductive elements through a statistical inverse technique called 'simulated annealing'. The fracture network model is 'annealed' until the modified systems behaves like the observed. The further development of the approach continues at LBL and in a joint LBL/VTT collaboration project the possibilities to apply the technique in Finnish conditions are investigated.

4256 (VTT-SYMP–126, pp. 115-121) **THETA - A computer program for the simulation of coupled fluid, heat and solute transport in porous media.** Kangas, M. (Helsinki Univ. of Technology, Otaniemi (Finland). Dept. of Technical Physics); Lund, P. Technical Research Centre of Finland, Espoo (Finland). 1991. (In Finnish). (CONF-9105387–: Seminar on ground water modelling, Espoo (Finland), 9 May 1991). In *Ground water modelling.* 156p. Order Number DE93607107. Source: OSTI; NTIS; INIS.

In the study, a 3-dimensional microcomputer model for the simulation of coupled water, heat and solute transport in porous media has been developed. Typical run times on a 80486/33MHz microcomputer with 5000-7000 point grid range from 10 minutes to few hours. As to user interface, a menu-type input data file definition as well as on-line graphics are provided. A full menu based input data generation is also being developed.

4257 (VTT-SYMP–126, pp. 128-134) **Ground water modelling in artificial recharge projects.** Laukkanen, R. (Soil and Water Ltd, Helsinki (Finland)); Saijonmaa, L. Technical Research Centre of Finland, Espoo (Finland). 1991. (In Finnish). (CONF-9105387–: Seminar on ground water modelling, Espoo (Finland), 9 May 1991). In *Ground water modelling.* 156p. Order Number DE93607107. Source: OSTI; NTIS; INIS.

Decision-making is strongly based on modelling in two of our water supply projects concerning artificial ground water. The model used is a 2-dimensional flow and transport model using the element method. Due to sharp variations in Finnish soils, the modelling process is based on careful and detailed evaluation of basic hydrogeological data before and during model calibration.

4258 (VTT-SYMP–126, pp. 135-140) **Application of the MOC-model to a contaminated groundwater area in Kaerkoelae.** Forsius, J. (Imatran Voima Oy, Helsinki (Finland)). Technical

Research Centre of Finland, Espoo (Finland). 1991. (In Finnish). (CONF-9105387–: Seminar on ground water modelling, Espoo (Finland), 9 May 1991). In *Ground water modelling*. 156p. Order Number DE93607107. Source: OSTI; NTIS; INIS.

The two-dimensional groundwater model MOC, developed by U.S. Geological Survey was applied to the polluted groundwater area of Kaerkoelae. Since enough field data did not exist for calibration of the model, only the influence of different pumping rates and boundary conditions were investigated. It was found that the model was quite sensitive to the applied boundary conditions.

4259 (VTT-SYMP–126, pp. 141-154) **Groundwater model views vs. experience in surface waters.** Virtanen, M. (Suomen Ympaeristoevaikutusten Arviointikeskus Oy, Helsinki (Finland)). Technical Research Centre of Finland, Espoo (Finland). 1991. (In Finnish). (CONF-9105387–: Seminar on ground water modelling, Espoo (Finland), 9 May 1991). In *Ground water modelling*. 156p. Order Number DE93607107. Source: OSTI; NTIS; INIS.

The future use of the ground water models is viewed in the light of the highly successful surface water experiences. The key factors for progress in ground water applications are expected to include: Truly interactive coupling between the measurements and models. Simple but intelligent analysis of the field results aiming at understanding of their further meaning and of the real reasons for possible differences between the models and the measurements. Start from small-scale applications for real verification of the model validity and for proper directing of the model development to the most essential questions of the nature. Base of the models on the real decrees of nature, on universally valid elementary relations and on thinking of the causal dynamics as far as anything is known about them, Continuous further development of the models along with the applications - resulting usually quite soon in writing own model codes instead of fruitless fighting with the emerging mysteries, stiffness and limitations of the commercial computer programs. Close co-operation between people with different emphases, backgrounds and responsibilities including persons mainly interested in measurements, their interpretation, model development, decision making and in planning. Practical problems to be solved from the very beginning of the model work in order to force the results to be completed in time and to get the models involved in the most acute needs of planning and decision making at an early stage of their development.

4260 (WSRC-TR–92-179) **Ichthyoplankton entrainment study at the SRS Savannah River water intakes for Westinghouse Savannah River Company: Final report.** Paller, M. (Westinghouse Savannah River Co., Aiken, SC (United States)). Westinghouse Savannah River Co., Aiken, SC (United States); Dames and Moore, Atlanta, GA (United States). 26 Mar 1992. 405p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC09-89SR18035. Order Number DE93001346. Source: OSTI; NTIS; INIS; GPO Dep.

Cooling water for L and K Reactors and makeup water for Par Pond is pumped from the Savannah River at the 1G, 3G, and 5G pump houses. Ichthyoplankton (drifting fish larvae and eggs) from the river are entrained into the reactor cooling systems with the river water and passed through the reactor's heat exchangers where temperatures may reach 70°C during full power operation. Ichthyoplankton mortality under such conditions is assumed to be 100 percent. The number of ichthyoplankton entrained into the cooling system depends on a variety of variables, including time of year, density and distribution of ichthyoplankton in the river, discharge levels in the river, and the volume of water withdrawn by the pumps. Entrainment at the 1 G pump house, which is immediately downstream from the confluence of Upper Three Runs Creek and the Savannah River, is also influenced by discharge rates and ichthyoplankton densities in Upper Three Runs Creek. Because of the anticipated restart of several SRS reactors and the growing concern surrounding striped bass and American shad stocks in the Savannah River, the Department of Energy requested that the Environmental Sciences Section (ESS) of the Savannah River Laboratory sample ichthyoplankton at the SRS Savannah River intakes. Dams & Moore, Inc., under a contract with Westinghouse Savannah River Company performed the sampling and data analysis for the ESS.

4261 (WSRC-TR–92-193-Rev.1) **Tritium uptake by fish in a small stream: Revision 1.** Eaton, D.; Murphy, C.E. Jr. Westinghouse Savannah River Co., Aiken, SC (United States). 17 Sep 1992. 15p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC09-89SR18035. Order Number DE93001899. Source: OSTI; NTIS; INIS; GPO Dep.

The tritium concentration in the water from freeze drying and the water from combustion of the dry tissue was measured in fish (largemouth bass), stream macrophytes, and streamside vegetation at five sampling locations in Four Mile Branch on the Savannah River Site (SRS). Four Mile Branch has elevated tritium concentration, largely from migration of water through the soil from adjacent seepage basins that received industrial wastewater containing tritium. The stream water and the vegetation, through the food chain, are thought to be the two sources of tritium reaching the fish. Comparision of the tritium activity of the freeze-dried water from fish flesh and of the sources of tritium, indicates that the fish flesh approaches a steady-state concentration with the stream water. The freeze-dry water from the vegetation is also at a lower specific activity than the stream water. The water of combustion from the vegetation is also at a lower specific activity than stream water. The water of combustion from the fish flesh is somewhat higher in specific activity than the stream water or the water in the fish. The distribution of tritium among the components of this system can be explain in terms of the turnover of water and organic hydrogen in the components.

55 BIOMEDICAL SCIENCES, BASIC STUDIES

5501 Behavioral Biology

Refer also to citation(s) 4429

5502 Biochemistry

Refer also to citation(s) 2873, 2874, 2877, 2879, 2882, 2904, 4278, 4326, 4328

4262 (ANL/CP–76567) **Primary charge separation in isolated photosystem II reaction centers.** Seibert, M. (National Renewable Energy Lab., Golden, CO (United States)); Toon, S.; Govindjee; O'Neil, M.P.; Wasielewski, M.R. Argonne National Lab., IL (United States). 24 Aug 1992. 5p. Sponsored by USDOE, Washington, DC (United States); National Science Foundation, Washington, DC (United States). DOE Contract W-31109-ENG-38 ;AC02-83CH10093. (CONF-9208155–2: 9. international congress on photosynthesis, Nagoya (Japan), 30 Aug - 5 sep 1992). Order Number DE92041128. Source: OSTI; NTIS; GPO Dep.

Primary charge-separation in isolated bacterial reaction center (RC) complex occurs in 2.8 ps at room temperature and 0.7–1.2 ps at 10 K. Because of similarities between the bacterial and photosystem II (PSII) RCs, it has been of considerable interest to obtain analogous charge-separation rates in the higher plant system. Our previous femtosecond transient absorption studies used PSII RC material stabilized with PEG or by exchanging dodecyl maltoside (DM) for Triton in the isolation procedure. These materials gave charge-separation 1/e times of 3.0 $\pm$ 0.6 ps at 4°C and 1.4$\pm$ 0.2 ps at 15 K based on the risetime of transient absorption kinetics at 820 nm. These values were thought to represent the time required for formation of the $P680^+$-$Pheo^-$ state. Recent results of Hastings et al. obtained at high data acquisition rates and low flash intensities, suggest that the $Pheo^-$ state may form more slowly. In light of this work, we have carried out additional time domain studies of both electron transport and energy transfer phenomena in stabilized DM PSII RCs at room temperature. We used a 1-kHz repetition rate femtosecond transient absorption spectrometer with a 200 fs instrumental time resolution and compared the results with those obtained by others using frequency domain hole-burning techniques.

4263 (BNL–47954) **Multilayer monochromators and supermirrors for neutron protein crystallography using a quasi Laue**

technique. Schoenborn, B.P. Brookhaven National Lab., Upton, NY (United States). [1992]. 7p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC02-76CH00016. (CONF-920792–38: Society of Photo-Optical Instrumentation Engineers (SPIE) international symposium on optical applied science and engineering, San Diego, CA (United States), 19-24 Jul 1992). Order Number DE93001654. Source: OSTI; NTIS; GPO Dep.

The major problem in neutron protein crystallography is the low flux of present neutron sources. The collection of a data set using a conventional rotation technique and a 2D detector takes many weeks. One way to increase the flux at the sample is to increase the wavelength bandwidth. The conventional technique using a standard monochromator like Cu or Be has a typical bandwidth of 1%. A multilayer monochromator can however be tailored to give bandwidth up to 25% or even larger and have an angular acceptance angle of~ 3%. This can be achieved by a multiple spacing multilayer. In this case the diffraction geometry is such that the reflection in diffraction condition is "scanned" by the $\Delta\lambda$ and not by rotating the reciprocal lattice point through the Ewald sphere. Wavelength bandwidth of 10% satisfy this condition. It is important to tailor the bandwidth to the size needed by the extend of the reciprocal lattice "point" to minimize background. The intensity of the reflection is proportional to the $\Delta\lambda r$ that just covers the width of the reciprocal "point" while the background is proportional to the full wavelength spread $\Delta\lambda$ that hits the crystal. The conventional Laue technique is not suitable since it increases the background by the ratio of $\Delta\lambda\Delta\lambda r$, a ratio that can easily reach multiples of 10.

4264 (CONF-910550–, pp. 49-59) **Optimization of large-scale chromatography for biotechnological applications.** Peskin, A.P. (National Inst. of Standards and Technology, Boulder, CO (United States)); Rudge, S.R. National Renewable Energy Lab., Golden, CO (United States); Oak Ridge National Lab., TN (United States). 1992. From 13. symposium on biotechnology for fuels and chemicals; Colorado Springs, CO (United States); 6-10 May 1991. In *Thirteenth symposium on biotechnology for fuels and chemicals: Proceedings.* 846p. Source: The Humana Press, Inc., Totowa, NJ 07511 (United States).

An economic evaluation of a chromatographic separation is discussed. The effects of particle size, cycle time, solvent, and column costs are analyzed. With small particles (< 20 μm), the cost of the packing can be as much as 99% of the total cost of the process, whereas with large particles (> 60 μm), resin costs are less than half of the total. A strong optimum is found between 20-40 μm for maximum productivity, using both Gaussian models and the mass transfer model of Lapidus and Amundson to generate peaks. A new compilation of resin costs, column costs, and pump costs is given.

4265 (CONF-910550–, pp. 161-173) **Optimal nutrient feed policies for heterologous protein production.** Harcum, S.W. (Univ. of Maryland, College Park (United States)); Ramirez, D.M.; Bentley, W.E. National Renewable Energy Lab., Golden, CO (United States); Oak Ridge National Lab., TN (United States). 1992. From 13. symposium on biotechnology for fuels and chemicals; Colorado Springs, CO (United States); 6-10 May 1991. In *Thirteenth symposium on biotechnology for fuels and chemicals: Proceedings.* 846p. Source: The Humana Press, Inc., Totowa, NJ 07511 (United States).

Recombinant Escherichia coli, which overproduce heterologous protein, redirect endogenous metabolic activity to that mediated by the recombinant expression vector. Consequently, cells may experience perturbations in the biosynthetic reaction network, including the amino acid biosynthesis pathways. These cells are characterized by decreased growth rate, decreased cell mass yield, and increased heterologous protein degradation. This study investigates the dynamics of chloramphenicol-acetyl-transferase (CAT) synthesis and degradation in E. coli JM105 grown on minimal media, and correlates the observed phenomena with induction strength. Coordinated amino acid feeding was shown to increase the heterologous protein yield. Rational design of nutrient feeding possibilities is explored.

4266 (CONF-910550–, pp. 217-231) **Thermal denaturation of Trichoderma reesei cellulases studied by differential scanning calorimetry and tryptophan fluorescence.** Baker, J.O. (Solar Energy Research Inst., Golden, CO (United States)); Tatsumoto, K.; Grohmann, K.; Himmel, M.E.; Woodward, J.; Wichert, J.M.; Shoemaker, S.P. National Renewable Energy Lab., Golden, CO (United States); Oak Ridge National Lab., TN (United States). 1992. From 13. symposium on biotechnology for fuels and chemicals; Colorado Springs, CO (United States); 6-10 May 1991. In *Thirteenth symposium on biotechnology for fuels and chemicals: Proceedings.* 846p. Source: The Humana Press, Inc., Totowa, NJ 07511 (United States).

The thermal denaturation of four purified Trichoderma reesei cellulase components, cellobiohydrolase (CBH) I, CBH II, endoglucanase (EG) I, and EG II, has been monitored using a combination of classical temperature/activity profiles, differential scanning calorimetry (DSC), and thermal scanning fluorescence emission spectrometry. Significant correlations were found between the results of enzyme activity studies and the results obtained through the more direct physical approaches, in that both DSC and the activity studies showed EG II (T_m=75C) to be much more thermostable (by 10-11C) than the other three enzymes, all three of which were shown by both activity profiles and DSC to be very similar in thermal stability. The temperature dependence of the wavelength of maximum tryptophan emission showed a parallel result, with the three enzymes exhibiting less thermostable activity being grouped together in this regard, and EG II differing from the other three in maintaining a less-exposed tryptophan microenvironment at temperatures as high as 73C. The DSC results suggested that at least two transitions are involved in the unfolding of each of the cellulase components, the first (lower-temperature) of which may be the one correlated with activity loss.

4267 (CONF-910550–, pp. 247-259) **Purification and characterization of a xylanase from the thermophilic ascomycete Thielavia terrestris 255B.** Gilbert, M. (Univ. of Ottawa, ON (Canada)); Breuil, C.; Saddler, J.N.; Yaguchi, M. National Renewable Energy Lab., Golden, CO (United States); Oak Ridge National Lab., TN (United States). 1992. From 13. symposium on biotechnology for fuels and chemicals; Colorado Springs, CO (United States); 6-10 May 1991. In *Thirteenth symposium on biotechnology for fuels and chemicals: Proceedings.* 846p. Source: The Humana Press, Inc., Totowa, NJ 07511 (United States).

Thielavia terrestris 255B, a thermophilic ascomycete, produced two major forms of xylanase with pIs of 4.6 (xylanase I) and 6.1 (xylanase II). The latter enzyme could be purified to > 99% homogeneity using anion-exchange chromatography and gel filtration. Xylanase II had a mol wt of 25.7 kDa (SDS-PAGE) and a pH and a temperature optimum of 3.6-4.0 and 60-65C, respectively. The ratio of the enzyme's activity against xylan and carboxymethylcellulose was 500-1000 to 1, indicating a possible application of this enzyme in biobleaching processes. The amino acid sequence of this protein is being determined, and initial data suggest that the enzyme belongs to a group of low-mol wt xylanases that have been isolated from both bacteria and fungi.

4268 (CONF-910550–, pp. 261-272) **Mycelia-associated β-xylosidase in pellets of Aspergillus sps.** Stalbrand, H. (Univ. of Lund (Sweden)); Hahn-Hagerdal, B.; Tjerneld, F.; Reczey, K. National Renewable Energy Lab., Golden, CO (United States); Oak Ridge National Lab., TN (United States). 1992. From 13. symposium on biotechnology for fuels and chemicals; Colorado Springs, CO (United States); 6-10 May 1991. In *Thirteenth symposium on biotechnology for fuels and chemicals: Proceedings.* 846p. Source: The Humana Press, Inc., Totowa, NJ 07511 (United States).

A screening of 10 strains of Aspergillus for pellet formation and mycelia-associated β-xylosidase activity was performed in media containing glucose and glucose supplemented with methyl β-D-Xylopyranoside. The aim was to produce an immobilized enzyme preparation. Three strains with high mycelia-associated β-xylosidase activity were investigated for enzyme leakage and enzyme stability: A. terreus QM 1991, A. phoenicis ATCC 13157, and A. phoenicis QM 329. The pellets of A. phoenicis QM 329 had the highest β-xylosidase activity (280 IU/g dry wt mycelia) after 333 h of incubation. From measurements of both cell-bound enzyme activity and the activity in solution, it could be concluded that for Aspergillus phoenicis QM 329 and ATCC 13157 the decrease in β-xylosidase activity bound to the pellets was owing to enzyme

leakage. For Aspergillus terreus QM 1991, the decrease of pellet-bound β-xylosidase activity was the result of both leakage and enzyme deactivation at 50C. β-Xylosidase in pellets of A. phoenicis QM329 hydrolyzes xylobiose and p-nitrophenyl β-D-xylopyranoside with the same rate of conversion.

4269 (CONF-910550–, pp. 283-295) **The anionic glycan from the cactus Cereus peruvianus.** Alvarez, M. (Natural Products Lab., Maringa (Brazil)); Costa, S.C.; Utumi, H.; Huber, A.; Beck, R.; Fontana, J.D. National Renewable Energy Lab., Golden, CO (United States); Oak Ridge National Lab., TN (United States). 1992. From 13. symposium on biotechnology for fuels and chemicals; Colorado Springs, CO (United States); 6-10 May 1991. In *Thirteenth symposium on biotechnology for fuels and chemicals: Proceedings.* 846p. Source: The Humana Press, Inc., Totowa, NJ 07511 (United States).

The columnar cactus Cereus peruvianus provides various compounds of interest that account for most of its 10% dry wt content. Included are acidic gum and cellulose as the highly polymerized carbohydrate components, and a complex waxy lipid fraction. The major gum fraction (1.5 g% of the fresh phytobiomass on single aqueous extraction) is an uronylated rhamnoarabinogalactan whose intrinsic viscosity may exceed 1000 mL/g. Its rheological behavior is, in part, influenced by the native o-acetyl and cation components, mainly Ca^{2+}. A pigment-freepcwdered gum was obtained by precipitating and washing the fresh mucilage with 2-3 vol of ethanol. The almost protein-free polysaccharide forms viscous solution upon redissolution. The possible uses to be investigated for the pretreated cactus gum will be as an adjuvant in the flocculation of water impurities and in formulation of cosmetics.

4270 (CONF-910550–, pp. 297-308) **Fructose and fructose-anhydrides from Dahlia inulin.** Hauly, M. (Dept. Chemistry, Londrina (Brazil)); Bracht, A.; Beck, R.; Fontana, J.D. National Renewable Energy Lab., Golden, CO (United States); Oak Ridge National Lab., TN (United States). 1992. From 13. symposium on biotechnology for fuels and chemicals; Colorado Springs, CO (United States); 6-10 May 1991. In *Thirteenth symposium on biotechnology for fuels and chemicals: Proceedings.* 846p. Source: The Humana Press, Inc., Totowa, NJ 07511 (United States).

Inulin from Dahlia spp. tubers (50 g% yield, dry basis; 12.5 g% yield, wet basis) competes with Jerusalem artichoke and chicory as a source of fructose. Mild acid hydrolysis under pH control instead of nominal acid concentration of aqueous orthophosphoric acid resulted in almost quantitative monomerization of the labile fructan backbone. Byproducts hydroxymethylfurfural (HMF), (di)fructose anhydrides (DFA), and oligosaccharides were minimized. Microflora were collected from rotting Dahlia, and an inuloytic mold, able to metabolize HMF, as well as bacteria-producing DFA III were recovered. Microbiologically synthesized DFA was tested for biological activity using isolated rat liver perfusion.

4271 (CONF-910550–, pp. 317-329) **Use of chemostat for enhanced production of β-glucosidase by newly isolated anaerobic cellulolytic Clostridium strain RT9.** Tabassum, R. (Nuclear Inst. for Agriculture and Biology, Faisalabad (Pakistan)); Rajoka, M.I.; Malik, K.A. National Renewable Energy Lab., Golden, CO (United States); Oak Ridge National Lab., TN (United States). 1992. From 13. symposium on biotechnology for fuels and chemicals; Colorado Springs, CO (United States); 6-10 May 1991. In *Thirteenth symposium on biotechnology for fuels and chemicals: Proceedings.* 846p. Source: The Humana Press, Inc., Totowa, NJ 07511 (United States).

A new anaerobic, mesophilic, spore-forming, cellulolytic Clostridium strain, RT9, was isolated from bovine rumen fluid. This strain has the ability to hydrolyze cellulose (Sigma cell-100), carboxymethyl-cellulose (CMC), and cellobiose into ethanol, acetate, butyrate, lactate, acetone, H_2, and CO_2 as the major fermentation products. The bacterium also exhibited endoglucanase, exoglucanase, and β-glucosidase activities in batch culture during growth on chemically defined medium with cellulose as the sole carbon source. Chemostat experiments were conducted under pH, dilution rate, and carbohydrate limitations to study the effect of various parameters on enzymes and product formation. In chemostat with 0.5% cellobiose as the limiting product formation. β-glucosidase activity and ethanol production nutrient, maximum occurred at pH values of 5.5 and 6.5, respectively. At low accumulation was higher. β-glucosidase production increased up to 17-fold at a low dilution rate, and ethanol raised twofold. Relative activity of β-glucosidase on a percent basis was maximum at pH 45C. In a carbon-limited, continuous-culture experiment, when CMC was used as an inducer in cellobiose-growing culture, β-glucosidase activity was higher than the cellobiose-limited chemostat. On the other hand, enzyme declined twofold, and ethanol production increased in glucose limitation.

4272 (CONF-910550–, pp. 477-486) **A two-phase method to produce gel beads: Application in the design of a whole cell β-galactosidase catalyst.** Castillo, E. (Centro de Investigacion sobre Ingenieria Genetica y biotecnologia, Cuernavaca (Mexico)); Casas, L.; Munguia-Lopez, A.; Ramirez, D. National Renewable Energy Lab., Golden, CO (United States); Oak Ridge National Lab., TN (United States). 1992. From 13. symposium on biotechnology for fuels and chemicals; Colorado Springs, CO (United States); 6-10 May 1991. In *Thirteenth symposium on biotechnology for fuels and chemicals: Proceedings.* 846p. Source: The Humana Press, Inc., Totowa, NJ 07511 (United States).

A method for producing entrapped whole cell biocatalyst is described. The procedure consists of the direct mixing of a gel suspension with an oily phase. Three biopolymers are used: gelatin, agar, and carrageenan using K. fragilis cells containing β-galactosidase activity as a design model. For a given gel type and concentration, the bead's particle size is a direct function of the agitation rate and the type of impeller, as well as the geometry of the system. Therefore, the particle size distribution is obtained as a function of the impeller's Reynolds number in order to define a scale-up criteria. The β-galactosidase biocatalyst is characterized considering the effect of particle size and substrate concentration on the effectiveness factor. This method does not require the usual extrusion equipment and, as shown here, is adequate for scaling up.

4273 (CONF-910550–, pp. 487-498) **The one-dimensional biocatalyst: A research tool for in situ analysis of immobilized-cell biocatalysts.** Worden, R.M. (Michigan State Univ., East Lansing (United States)); Berry, L.G. National Renewable Energy Lab., Golden, CO (United States); Oak Ridge National Lab., TN (United States). 1992. From 13. symposium on biotechnology for fuels and chemicals; Colorado Springs, CO (United States); 6-10 May 1991. In *Thirteenth symposium on biotechnology for fuels and chemicals: Proceedings.* 846p. Source: The Humana Press, Inc., Totowa, NJ 07511 (United States).

A new method to culture and analyze cells entrapped in porous gels has been developed that enables the properties of living, immobilized cells to be measured in situ as a function of depth within the gel. The method employs scanning fluorescence microscopy, which can provide rapid, sensitive, noninvasive measurements with a resolution of < 1 mn. Any chemical species or cellular component that can be fluorescently marked can, in principle, be studied using this technique. Two applications of the approach are illustrated: measurement of transient diffusion rates within calcium alginate gel and monitoring growth of immobilized Escherichia coli cells.

4274 (DOE/ER/14005–T2) **[Molecular, genetic and physiological analysis of photoinhibition and photosynthetic]: Progress report, June 1991–November 1992.** Duke Univ., Durham, NC (United States). [1992]. 8p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG05-89ER14005. Order Number DE93004365. Source: OSTI; NTIS; GPO Dep.

A major goal of this project is to use a combined molecular genetic, biochemical and physiological approach to understand the relationship between photosynthetic performance and the structure of the multifunctional D1 reaction center protein of Photosystem II encoded by the chloroplast psbA gene. Relative to other chloroplast proteins, turover of D1 is rapid and highly light dependent and de novo synthesis of D1 is required for a plant's recovery from short term exposure to irradiances which induce photoinhibitory damage. These observations have led to models for a damage/repair cycle of PSII involving the targeted degradation and replacement of photodamaged D1. To investigate the effects of perturbing the D1 cycle on photosynthesis and autotrophic growth under high

and low irradiance, we have examined the consequences of site-specific mutations of the psbA and 16S rRNA genes affecting synthesis, maturation and function/stability of the D1 protein introduced into the chloroplast genome of wildtype strain of the green alga Chlamydomonas reinhardtii using biolistic transformation.

4275 (DOE/ER/61125–2) **Ultrasensitive fluorescence detection of DNA: Progress report, February 1, 1991–January 31, 1992.** Mathies, R.A.; Glazer, A.N. California Univ., Berkeley, CA (United States). Dept. of Chemistry. [1992]. 7p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG03-91ER61125. Order Number DE93004145. Source: OSTI; NTIS; GPO Dep.

We have shown that a number of polycationic highly fluorescent dyes form complexes with double-stranded DNA (ds-DNA) which are stable to electrophoresis and have characterized in detail such dsDNA complexes with TOTO (1,1′-(4,4,7,7-tetramethyl-4,7-diazaundecamethylene)-bis-4-[3-methyl-2,3-dihydro-(ben tetraiodide) and oxazole yellow dimer (YOYO; an analogue of TOTO with a benzo-1,3-oxazole in place of the benzo-1,3-thiazole). TOTO and YOYO are virtually non-fluorescent in solution, but form highly fluorescent complexes with dsDNA, up to a maximum dye to DNA bp ratio of 1:4, with >1000-fold fluorescence enhancement. We have developed an assay using YOYO for the quantitation of single-stranded and dsDNA in solution applicable over a range of DNA concentrations from 0.5 to 100 ng per ml. The fluorescent dsDNA-dye complexes allow detection of dsDNA on agarose and acrylamide gels with picogram sensitivity. We have applied these complexes in multiplex mapping experiments for accurate sizing and quantitation of restriction fragments. We have shown that in gel shift experiments the stable dsDNA-dye complexes can be used to detect heteroduplex-Muts complexes with a sensitivity comparable to radioisotopic detection.

4276 (LA-UR–92-1909) **An efficient bit string implementation of a database cross-field association system (with an application to protein sequence patterns).** Guigo, R. (Los Alamos National Lab., NM (United States)); Vazquez, I.; Smith, T.F. Los Alamos National Lab., NM (United States). [1992]. 33p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. (CONF-930117–1: 26. Hawaiian international conference on system science: biotechnology computing track, Kauai, HI (United States), 5-8 Jan 1993). Order Number DE92017525. Source: OSTI; NTIS; GPO Dep.

We present a fast implementation of an algorithm to infer correlation between database queries. The implementation has been primarily designed to automatically obtain the best description for the function of a given protein sequence pattern. We assume that such a description is the query on the functional annotation of a protein sequence database having the closet extension in the database to the extension of the pattern. The functional annotation of a protein sequence database can be described as a set-valued attribute whose domain is a set of one-place predicates with biological meaning. The query language is then a first order language and the query space can be mapped into a set algebra in which a measure of set similarity is introduced. We have previously developed an algorithm to search such an algebra when negation is not considered. Here, we present an efficient implementation of such and algorithm and we develop a method to search exhaustively a protein sequence database for biologically relevant protein sequence patterns, incorporating such an implementation. The method relies on the initial generation of an extensive collection of amino acid sequence motifs that correspond to high information dense regions in long consensus patterns derived from homologous protein families -and their automatic evaluation using above implementation. We have used this method to automatically search the SWISSPROT protein sequence database. The results obtained show that potentially meaningful amino acid sequence patterns may have been discovered.

4277 (LA-UR–92-3445) **Human retroviruses and aids, 1992: A compilation and analysis of nucleic acid and amino acid sequences.** Myers, G. (Los Alamos National Lab., NM (United States)); Korber, B. (eds.); Berzofsky, J.A.; Pavlakis, G.N. (eds.); Smith, R.F. (ed.). Los Alamos National Lab., NM (United States). Oct 1992. 684p. Sponsored by Department of Health and Human Services, Washington, DC (United States). DOE Contract W-7405-ENG-36. Order Number DE93004632. Source: OSTI; NTIS; GPO Dep.

Includes 5 1/4" diskettes (2) designed to run on IBM PC-compatible and Macintosh computers.

This compendium and the accompanying floppy diskettes are the result of an effort to compile and rapidly publish all relevant molecular data concerning the human immunodeficiency viruses (HIV) and related retroviruses. The scope of the compendium and database is best summarized by the five parts that it comprises: (1) HIV and SIV Nucleotide Sequences; (H) Amino Acid Sequences; (III) Analyses; (IV) Related Sequences; and (V) Database Communications. information within all the parts is updated at least twice in each year, which accounts for the modes of binding and pagination in the compendium. While this publication could take the form of a review or sequence monograph, it is not so conceived. Instead, the literature from which the database is derived has simply been summarized and some elementary computational analyses have been performed upon the data. Interpretation and commentary have been avoided insofar as possible so that the reader can form his or her own judgments concerning the complex information. In addition to the general descriptions below of the parts of the compendium, the user should read the individual introductions for each part.

5503 Cytology

Refer also to citation(s) 4017

5504 Genetics

Refer also to citation(s) 4275, 4277, 4326

4278 (LA-UR–92-1850) **Calculating shared fragments for the single digest problem.** Soderlund, C. (Los Alamos National Lab., NM (United States)); Torney, D.; Burks, C. Los Alamos National Lab., NM (United States). [1992]. 17p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. (CONF-930117–2: 26. Hawaiian international conference on system science: biotechnology computing track, Kauai, HI (United States), 5-8 Jan 1993). Order Number DE92017501. Source: OSTI; NTIS; GPO Dep.

A partial restriction map can be computed by using single digest fragments from a set of clones that are known to be in a contig. If there is no error or uncertainty in the data so that the set of unique restriction fragments can be calculated exactly, then the restriction map can be assembled using a polynomial-time algorithm based on the consecutive 1's property. However, there is typically both error and uncertainty in the data, which we WW describe in this paper. The data we are using is from the chromosome 16 mapping project at Los Alamos National Laboratory. We have developed an algorithm that consists of two steps: (1) calculate the set of unique restriction fragments and (2) assemble the fragments so that the set of fragments for each clone is contiguous. We present our algorithm for calculating the most probable set of unique fragments.

5505 Metabolism

Refer also to citation(s) 4261, 4268, 4327

5506 Medicine

Refer also to citation(s) 4323, 4346, 4347, 4352

4279 (DOE/ER/60400–6) **[Bifunctional chelates of Rh-105, Au-199, and other metallic radionuclides as potential radiotherapeutic agents].** Missouri Univ., Columbia, MO (United States). Dept. of Chemistry. [1991]. 55p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG02-86ER60400. Order Number DE93003146. Source: OSTI; NTIS; INIS; GPO Dep.

Progress during this period is reported under the following headings: Diethylenetriamine based and related bifunctional chelating agents and their complexation with Rh-105, Au-198, Pd-109, cu-67, In-111, and Co-57; studies of Pd-109, Rh-105 and Tc-99m with bifunctional chelates based on phenylenediamine; establishment of

an appropriate protein assay method for conjugated proteins; studies of new bifunctional Bi, Tri and tetradentate amine oxime ligands with Rh-105; IgG and antibody B72.3 conjugation studies by HPLC Techniques with bifunctional metal chelates; and progress on ligand systems for Au(III).

4280 (DOE/ER/60639–5) **Radiopharmaceuticals for diagnosis and treatment: Progress report.** Kuhl, D.E. Michigan Univ., Ann Arbor, MI (United States). Div. of Nuclear Medicine. 1992. 6p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG02-88ER60639. Order Number DE93004637. Source: OSTI; NTIS; INIS; GPO Dep.

We report on our efforts in PET basic radiochemistry, radiopharmaceutical synthesis, and preclinical radiopharmaceutical evaluation. These efforts are focused on three fronts. First predictive abilities in nucleophilic aromatic substitution with [^{18}F]fluorination of substituted aromatic rings. Although radiochemical yields can be predicted within a very similar group of compounds with similar leaving groups and substituent patterns, generalization to all nucleophilic substitutions with [^{18}F] fluoride is not warranted. Kinetic studies indicate significantly different rates of reactions, depending on ring substituents. Second, preclinical evaluation of new radiopharmaceuticals. We have synthesized and begun the preclinical evaluation of [^{11}C]tetrabenazine, a new radioligand based on the vesicular monoamine transport system. Third, our work, on [^{18}F]fluorination/decarbonylation reactions, structure-activity relationships in dopamine uptake inhibitors and effects of chronic drugs on radioligand binding is described.

4281 (DOE/ER/61091–T1) **[Non-invasive evaluation of the cardiac autonomic nervous system by PET]: Progress report.** Michigan Univ., Ann Arbor, MI (United States). [1992]. 7p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG02-90ER61091. Order Number DE93004636. Source: OSTI; NTIS; INIS; GPO Dep.

C-11 hydroxy ephedrine, introduced as the first clinically usable norepinephrine analogue, studies employing normal volunteers and patients with various cardiac disorders was found to valuable as a nonadreneric tracer. Simultaneously, animal studies been used to assess its use following ischemic injury in order to define neuronal damage. Current research focuses on the comparison of C-11 hydroxyephedrine with other neurotransmitters such as C-11 epinephrine and C-11 threohydroxyephedrine. Epinephrine is primarily stored in vesicles of the nerve terminal, while threohydroxyephedrine is only substrate to uptake I mechanism. Such a combination of radiotracers may allow the dissection of uptake I mechanism as well as vesicular storage. In parallel to the refinement of presynaptic tracers for the sympathetic nervous system, we are developing radiopharmaceuticals to delineate the adrenergic receptors in the heart. The combined evaluation of pre- and postsynaptic nerve function will improve our ability to identify abnormalides. We are currently developing a new radiosynthesis of the hydrophilic adrenergic receptor antagonist C-11 CGP-12177 which has been used by others for the visualization of adrenergic receptors in the heart. We are developing radiopharmaceuticals, for the delineation of presynaptic cholinergic nerve terminals. Derivatives of benzovesamicol have been labeled in our institution and are currently under investigation. The most promising agent is F-18 benzovesamicol (FEBOBV) which allows the visualization of parasympathetic nerve terminals in the canine heart as demonstrated by, preliminary PET data.

4282 (EGG-BNCT–10016-03/04) **INEL BNCT Research Program, March/April 1992.** Venhuizen, J.R. EG and G Idaho, Inc., Idaho Falls, ID (United States). Sep 1992. 21p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC07-76ID01570. Order Number DE93001931. Source: OSTI; NTIS; GPO Dep.

This report presents summaries for two months of current research for the Idaho National Engineering Laboratory (INEL) Boron Neutron Capture Therapy (BNCT) Program. Information is presented on development and murino screening experiments of low-density lipoprotein, carboranyl alanine, and liposome boron containing compounds. Pituitary tumor call culture studies are described. Drug stability, pharmacology and toxicity evaluation of borocaptate sodium (BSH) and boronopheoylalanine (BPA) are described. Treatment protocol development via the large animal (canine) model studies and physiological response evaluation in rats are discussed. Supporting technology development and technical support activities for boron drug biochemistry and purity, analytical and measurement dosimetry, and noninvasive boron quantification activities are included for the current time period. Current publications for the two months are listed.

4283 (INIS-BR–3003) **The hyperfractionation in the oropharynx carcinomas treatment: stages III and IV.** Pinto, L.H.J. Universidade do Estado, Rio de Janeiro, RJ (Brazil). Inst. de Biologia. 1990 84p. (In Portuguese). Order Number DE93607533. Source: OSTI; NTIS (US Sales Only); INIS.

From April 1986 until May 1989. 112 patients with stages III and IV oropharynx carcinomas were included in a protocol comparing the use of Hyperfractionation and Conventional Fractionation. The doses were 6600 rad in 33 fractions of 200 rad for the conventional fractionation and 7040 rad in 64 fractions, two fractions of 110 rad per day for the hyperfractionation. As of January 1990 an analysis was performed in 98 patients, with a median follow-up of 14 months. The probability of complete responses in the oropharynx was 74%, with 84% for the hyperfractionation and 64% for the conventional fractionation ($p < 0,05$). Survival was improved in 42 months for those patients treated with hyperfractionation: 27% versus 8% ($p < 0,05$). In patients with lesions out of the base of the tongue and in those with Karnofsky performance status of 50%, 60% and 70%, survival was improved with the use of hyperfractionation $p = 0,02$ and p 0,006 respectively. The study demonstrates the superiority of hyperfractionation over the classical fractionation in the treatment of patients with carcinoma of the oropharynx. (author).

4284 (INIS-BR–3024) **Monte Carlo calculations for doses in organs and tissues to oral radiography.** Sampaio, E.V.M. Universidade do Estado, Rio de Janeiro, RJ (Brazil). Centro Biomedico. 1985 123p. (In Portuguese). Order Number DE93607540. Source: OSTI; NTIS (US Sales Only); INIS.

Using the MIRD 5 phantom and Monte Carlo technique, organ doses in patients undergoing external dental examination were calculated taking into account the different x-ray beam geometries and the various possible positions of x-ray source with regard to the head of the patient. It was necessary to introduce in the original computer program a new source description specific for dental examinations. To have a realistic evaluation of organ doses during dental examination it was necessary to introduce a new region in the phantom heat which characterizes the teeth and salivary glands. The attenuation of the x-ray beam by the lead shield of the radiographic film was also introduced in the calculation. (author).

4285 (INIS-BR–3034) **Mandible osteoradionecrosis. Incidence and clinical evaluation of its therapy.** Biazolla, E.R. UNESP, Aracatuba, SP (Brazil). Faculdade de Odontologia. 1989 56p. (In Portuguese). Order Number DE93607534. Source: OSTI; NTIS (US Sales Only); INIS.

The incidence and the efficiency of mandible osteoradionecrosis in patients with oral neoplasms and submitted to radiotherapy were studied. The osteoradionecrosis incidence in mandible was 6,67%. The treatment with sodium iodide 2% and hydrogen peroxide 10 v was the best treatment for mandible osteoradionecrosis. (L.M.J.).

4286 (LBL–32488) **The use of geometric prior information in Bayesian tomographic image reconstruction: A preliminary report.** Lacer, J. (Lawrence Berkeley Lab., CA (United States)); ter Haar Romeny, B.M.; Viergever, M.A. Lawrence Berkeley Lab., CA (United States). Jun 1992. 15p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC03-76SF00098. (CONF-9207152–1: Society of Photo-Optical Instrumentation Engineers (SPIE) mathematical methods in medical imaging, San Diego, CA (United States), 22-23 Jul 1992). Order Number DE92041215. Source: OSTI; NTIS; GPO Dep.

In this paper we examine the possibility of using pure geometrical information from a prior image to assist in the reconstruction of tomographic data sets with lower number of counts. The situation can arise in dynamic studies, for example, in which the sum image from a number of time frames is available, defining desired

regions-of-interest (ROI's) with good accuracy, and the time evolution of uptake in those ROI's needs to be obtained from the low count individual data sets. 'the prior information must be purely geometrical in such a case, so that the activity in the ROI's of the prior does not influence the estimated uptake from the individual time frames. It is also desired that the prior does not impose any other conditions on the reconstructions, i.e., no smoothness or deviation from a known set of values is desired. We attack this problem in the framework of Vision Response Functions (VRFs), based on the work done by J.J. Koenderink in Utrecht. We show that there are assemblies of VRF's that can be presented in a form that is invariant with respect to rotations and translations and that some functions of those invariants can convey the desired geometric prior information independent of the level of activity in the ROI'S, except at very low levels.

4287 (LBL-PUB–5348) **Proton Therapy Research and Treatment Center.** Goodnight, J.E. Jr. (University of California Davis Medical Center, Sacramento, CA (United States). Cancer Center); Alonso, J.R. Lawrence Berkeley Lab., CA (United States). 1 May 1992. 52p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC03-76SF00098. Order Number DE92041202. Source: OSTI; NTIS; GPO Dep.

This Grant proposal outlines the steps that will be undertaken to bring the UC Davis Proton Therapy Research and Treatment, known locally as the Proton Therapy Facility (PTF), through its design and construction phases. This application concentrates on the design phase of the PTF project.

4288 (LUNFD6-NFRA–1027-1-34-1992) **Magnetic field perturbation in proton MR imaging - A study of a contrast agent and of distortions due to metallic implants.** Olsson, M. Lund Univ. (Sweden). Dept. of Radiation Physics. 1992. 34p. (LUMEDW-MERI–1027-1-34-1992.). Order Number DE93607495. Source: OSTI; NTIS; INIS.

Perturbations of the static magnetic field in proton MR imaging (NMR imaging, MRI, MRT) result in image distortion and/or signal loss. An investigation of a superparamagnetic contrast agent for MR imaging has been performed. Magnetite particles were embedded in biodegradable starch spheres with a diameter of one micrometer. Animal experiments showed that the agent was quickly accumulated in the reticulo-endothelial system (RES), causing a decrease in signal intensity in this region. Diffusion within the locally generated magnetic field perturbation is responsible for signal loss in spin-echo images. Furthermore, the magnetic properties of various aneurysm clips were investigated to determine which clips could be used safely in a clinical MR investigation. MR artifacts caused by the metallic clips were studied using a geometric phantom. Non-ferromagnetic clips were concluded to be safe for examinations with medium field (0.3 tesla) MR imaging systems. A comparison study between MR and CT was performed on patients harbouring intracranial, nonferromagnetic aneurysm clips. The artifacts close to the clips were equally serve for MR and CT, but at some distance, the MR images were much less affected than the CT images. Finally, a computer program capable of simulating any realistic MR imaging situation has been developed. Raw data matrices are obtained by solving the Bloch equations. Corrections for intravascular spin behaviour have been implemented together with efficient algorithms. A quantitative investigation of signal displacement and signal loss, caused by small metallic implants, has been performed by computer simulation. An exact expression for the magnetic field outside a homogeneous ellipsoid in an external magnetic field has been derived. Distortions in MR images, caused by perturbing ellipsoids of different shapes and orientations, were studied. (30 refs.) (au).

4289 (ORNL/TM–12010) **Production capabilities in US nuclear reactors for medical radioisotopes.** Mirzadeh, S. (Oak Ridge National Lab., TN (United States)); Callahan, A.P.; Knapp, F.F. Jr.; Schenter, R.E. Oak Ridge National Lab., TN (United States). Nov 1992. 192p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. Order Number DE93003669. Source: OSTI; NTIS; INIS; GPO Dep.

The availability of reactor-produced radioisotopes in the United States for use in medical research and nuclear medicine has traditionally depended on facilities which are an integral part of the US national laboratories and a few reactors at universities. One exception is the reactor in Sterling Forest, New York, originally operated as part of the Cintichem (Union Carbide) system, which is currently in the process of permanent shutdown. Since there are no industry-run reactors in the US, the national laboratories and universities thus play a critical role in providing reactor-produced radioisotopes for medical research and clinical use. The goal of this survey is to provide a comprehensive summary of these production capabilities. With the temporary shutdown of the Oak Ridge National Laboratory (ORNL) High Flux Isotope Reactor (HFIR) in November 1986, the radioisotopes required for DOE-supported radionuclide generators were made available at the Brookhaven National Laboratory (BNL) High Flux Beam Reactor (HFBR). In March 1988, however, the HFBR was temporarily shut down which forced investigators to look at other reactors for production of the radioisotopes. During this period the Missouri University Research Reactor (MURR) played an important role in providing these services. The HFIR resumed routine operation in July 1990 at 85 MW power, and the HFBR resumed operation in June 1991, at 30 MW power. At the time of the HFBR shutdown, there was no available comprehensive overview which could provide information on status of the reactors operating in the US and their capabilities for radioisotope production. The obvious need for a useful overview was thus the impetus for preparing this survey, which would provide an up-to-date summary of those reactors available in the US at both the DOE-funded national laboratories and at US universities where service irradiations are currently or expected to be conducted.

4290 **Process for measuring low cadmium levels in blood and other biological specimens.** Peterson, D.P.; Huff, E.A.; Bhattacharyya, M.H. To Dept. of Energy. 29 Jan 1991. USAA patent application 7-647,07. 29p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-31109-ENG-38. Order Number DE93001990. Source: OSTI; NTIS; GPO Dep.

A process for measuring low levels of cadmium in blood and other biological specimens is provided without interference from high levels of alkali metal contaminants by forming an aqueous solution and without contamination by environmental cadmium absent the proteins from the specimen, selectively removing cadmium from the aqueous solution on an anion exchange resin, thereby removing the alkali metal contaminants, resolubilizing cadmium from the resin to form a second solution and analyzing the second solution for cadmium, the process being carried out in a cadmium-free environment.

4291 **Thermal manipulator of medical catheters.** Chastagner, P. To Dept. of Energy. 4 Mar 1991. USAA patent application 7-663,49. 15p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC09-89SR18035. Order Number DE93002006. Source: OSTI; NTIS; GPO Dep.

This invention consists of a maneuverable medical catheter comprising a flexible tube having a functional tip. The catheter is connected to a control source. The functional tip of the catheter carries a plurality of temperature activated elements arranged in parallel and disposed about the functional tip and held in spaced relation at each end. These elements expand when they are heated. A plurality of fiber optic bundles, each bundle having a proximal end attached to the control source and a distal end attached to one of the elements carry light into the elements where the light is absorbed as heat. By varying the optic fiber that is carrying the light and the intensity of the light, the bending of the elements can be controlled and thus the catheter steered. In an alternate embodiment, the catheter carries a medical instrument for gathering a sample of tissue. The instrument may also be deployed and operated by thermal expansion and contraction of its moving parts.

5507 Microbiology

Refer also to citation(s) 2862, 4277, 4301

4292 (CONF-910550–, pp. 175-183) **Improvement of cellulase activity in Trichoderma.** Sandhu, D.K. (Guru Nanak Dev Univ., Amritsar (India)); Bawa, S. National Renewable Energy Lab., Golden, CO (United States); Oak Ridge National Lab., TN (United States). 1992. From 13. symposium on biotechnology for fuels and

chemicals; Colorado Springs, CO (United States); 6-10 May 1991. In *Thirteenth symposium on biotechnology for fuels and chemicals: Proceedings.* 846p. Source: The Humana Press, Inc., Totowa, NJ 07511 (United States).

The conditions for the production and regeneration of protoplasts from Trichoderma reesei QM 9414 were optimized. Mutants obtained from Trichoderma reesei QM 9414 were crossed, using protoplast fusion. In the crosses attempted, the diploids showed enhanced yields of exoglucanase, whereas the yield of endoglucanase and β-glucosidase was intermediate as compared to their respective parents. In some of the segregants, the yields were further enhanced, indicating the use of protoplast fusion techniques in developing breeding strategies for strain improvement. The study of cellulase mutants as such and the segregants revealed that the three cellulase components appear to be regulated independently of each other.

5509 Pathology

Refer also to citation(s) 4051, 4277

5510 Physiological Systems

Refer also to citation(s) 4051, 4180, 4384

5530 Agriculture and Food Technology

Refer also to citation(s) 2854, 3487, 3489, 3490, 3673, 4103, 4110, 4132, 4180

4293 (AECS-A/RRE–3) **The effect of irradiation of barley seeds with low doses on the increase of their resistance to salinity during germination period.** Al-Ain, Farid (Atomic Energy Commission, Damascus (Syrian Arab Republic)); Sharabi, N.E. Atomic Energy Commission, Damascus (Syrian Arab Republic). Jun 1992. 41p. (In Arabic). Order Number DE93607285. Source: OSTI; NTIS (US Sales Only); INIS.

Seeds of barley variety (ACSAD- 176) were irradiated with (0, 10, 15, 20, 30 and 40 Gy) of gamma rays, and sown in two different media, one is a solution and the other is soil. In each medium four different concentrations of salinity (0, 7, 12 and 17 m.m/cm) where used. For the solution medium four replicates were used in a randomized complete block design. For the soil three replicates were used in a complete randomized design Factorial type. Germination percentage (%G) and plants height (P.h) were measured. In the solution medium the results showed significant increase in the (%G) between the control and the doses 10, 15, and 20 Gy at salinity concentration of 7 m.m/cm. However at salinity concentrations of 12 and 17 m.m/cm there was significant increase for the doses 10, 15, 20 and 30 Gy. As for the effect on (P.h) there was a nonsignificant increase for all the doses of salinity concentrations of 0 and 7 m.m/cm compared to the control. However a doses of 10 Gy resulted in a nonsignificant increase at all salinity concentrations. In the soil the results showed that only at salinity concentration of 17 m.m/cm all the doses showed significant increase in the (%G) compared to the control, there was a nonsignificant increase at the doses of 10 Gy and salinity concentration of 7 m.m/cm, however for salinity concentration of 12 m.m/cm the doses of 15 and 20 Gy caused nonsignificant increase. For (P.h) all doses caused a nonsignificant increase at one salinity concentration (17 m.m/cm) only. (author). 24 refs., 51 figs., 16 tabs.

4294 (AECS-A/RRE–4) **Dinitrogen fixation estimates in vetch-barley swards using ^{15} N methodology.** Kurdali, Fawaz (Atomic Energy Commission, Damascus (Syrian Arab Republic)); Sharabi, N.E. Atomic Energy Commission, Damascus (Syrian Arab Republic). Jul 1992. 16p. (In Arabic). Order Number DE93607286. Source: OSTI; NTIS (US Sales Only); INIS.

N_2 fixation in vetch (Vicia Sativa) grown alone and in mixture with barley (Hordeum vulgare) in pots was evaluated using ^{15} N isotope dilution method. Two harvests were made over the growing season. The proportion of the above-ground N derived from atmospheric N_2 (% Ndfa) in mixed vetch was significantly higher than that of vetch in pure culture for the different harvests. However, this increase was not accompanied with the amount of N_2 fixation. On the other hand, no significant differences were observed in N-content or in N-derived from soil between barley grown in mixture and in mono culture, in spite of the difference in the number of plants between the two cropping systems. These results indicate a high competing capacity of barley for soil nitrogen in mixed culture. So, in further investigations the vetch: barley seeding ratio must be considered in order to reduce the competition effect. Barley grown together with vetch had lower atom %^{15} N excess than barley grown in mono culture because it may have received some of their N from N-released by the legume in the second herbage but not in the first. On the other hand, nitrogen accumulation in the two successive harvests was higher than that in the plants harvested only once. Overall, these results indicate the importance of mixed crops for forage production. Based on these results, further investigation must be carried out in the field especially under rain-fed conditions. (author). 6 refs., 2 figs., 3 tabs.

4295 (AI-DOE–13557-Vol.4) **CACI: The Cesium-137 Agricultural Commodities Irradiator: Final design report: Volume 4, Specifications.** Rockwell International Corp., Canoga Park, CA (United States). Rocketdyne Div. Dec 1986. 597p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-85AL25763. Order Number DE93002433. Source: OSTI; NTIS; GPO Dep.

This report provides a complete description of the final detailed design of the Cesium-137 Agricultural Commodities Irradiator (CACI). The design was developed and successfully completed by the Rocketdyne Division of Rockwell International for the US Department of Energy (DOE). The CACI project was initiated in April 1985 under DOE's Byproducts Utilization Program, with the objectives of transferring food irradiation technology to the industry and thereby demonstrating a beneficial use for the ^{137}Cs nuclear by-product isotope. As designed, CACI will meet the intended requirements for research, development, and demonstration of irradiation processing of food. Further, as shown in the safety analyses performed during the project, the design conforms to all the safety and licensing requirements set forth for the project. The original scope of the CACI project included completion of its construction. However, the project was terminated for the convenience of the government during the final design phase in February 1986 for lack of a specific site. This Volume, IV, provides specifications as developed for the CACI final design.

4296 (AI-DOE–13557-Vol.5) **CACI: The Cesium-137 Agricultural Commodities Irradiator: Final design report: Volume 5, Plans, criteria, and requirements.** Rockwell International Corp., Canoga Park, CA (United States). Rocketdyne Div. 19 Dec 1986. 168p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-85AL25763. Order Number DE93002434. Source: OSTI; NTIS; GPO Dep.

This report provides a complete description of the final detailed design of the Cesium-137 Agricultural Commodities Irradiator (CACI). The design was developed and successfully completed by the Rocketdyne Division of Rockwell International for the US Department of Energy (DOE). The CACI project was initiated in April 1985 under DOE's Byproducts Utilization Program, with the objectives of transferring food irradiation technology to the industry and thereby demonstrating a beneficial use for the ^{137}Cs nuclear by-product isotope. As designed, CACI will meet the intended requirements for research, development, and demonstration of irradiation processing of food. Further, as shown in the safety analyses performed during the project, the design conforms to all the safety and licensing requirements set forth for the project. The original scope of the CACI project included completion of its construction. However, the project was terminated for the convenience of the government during the final design phase in February 1986 for lack of a specific site. The CACI final design is described in eight volumes. This Volume V, describes plans, criteria, and requirements.

4297 (AI-DOE–13557-Vol.6) **CACI: The Cesium-137 Agricultural Commodities Irradiator: Final design report: Volume 6, Shielding, mechanical, and electrical.** Rockwell International Corp., Canoga Park, CA (United States). Rocketdyne Div. 19 Dec 1986. 483p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-85AL25763. Order Number DE93002435. Source: OSTI; NTIS; GPO Dep.

This report provides a complete description of the final detailed design of the Cesium-137 Agricultural Commodities Irradiator (CACI). The design was developed and successfully completed by the Rocketdyne Division of Rockwell International for the US Department of Energy (DOE). The CACI project was initiated in April 1985 under DOE's Byproducts Utilization Program, with the objectives of transferring food irradiation technology to the industry and thereby demonstrating a beneficial use for the ^{137}Cs nuclear by-product isotope. As designed, CACI will meet the intended requirements for research, development, and demonstration of irradiation processing of food. Further, as shown in the safety analyses performed during the project, the design conforms to all the safety and licensing requirements set forth for the project. The original scope of the CACI project included completion of its construction. However, the project was terminated for the convenience of the government during the final design phase in February 1986 for lack of a specific site. This Volume, VI, provides the CACI final design features regarding shielding, mechanical and electrical.

4298 (AI-DOE–13557-Vol.7) **CACI: The Cesium-137 Agricultural Commodities Irradiator: Final design report: Volume 7, Safety analysis, thermal analysis, and thermal testing.** Rockwell International Corp., Canoga Park, CA (United States). Rocketdyne Div. 19 Dec 1986. 411p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-85AL25763. Order Number DE93002436. Source: OSTI; NTIS; GPO Dep.

This report provides a complete description of the final detailed design of the Cesium-137 Agricultural Commodities Irradiator (CACI). The design was developed and successfully completed by the Rocketdyne Division of Rockwell International for the US Department of Energy (DOE). The CACI project was initiated in April 1985 under DOE's Byproducts Utilization Program, with the objectives of transferring food irradiation technology to the industry and thereby demonstrating a beneficial use for the 137 Cs nuclear by-product isotope. As designed, CACI will meet the intended requirements for research, development, and demonstration of irradiation processing of food. Further, as shown in the safety analyses performed during the project, the design conforms to all the safety and licensing requirements set forth for the project. The original scope of the CACI project included completion of its construction. However, the project was terminated for the convenience of the government during the final design phase in February 1986 for lack of a specific site. The CACI final design is described in eight volumes. This volume, Volume VII, describes Safety Analysis, Thermal Analysis, and Thermal Testing.

4299 (AI-DOE–13557-Vol.8) **CACI: The Cesium-137 Agricultural Commodities Irradiator: Final design report: Volume 8, Shielding window.** Rockwell International Corp., Canoga Park, CA (United States). Rocketdyne Div. 19 Dec 1986. 470p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-85AL25763. Order Number DE93002437. Source: OSTI; NTIS; GPO Dep.

This report provides a complete description of the final detailed design of the Cesium-137 Agricultural Commodities Irradiator (CACI). The design was developed and successfully completed by the Rocketdyne Division of Rockwell International for the US Department of Energy (DOE). The CACI project was initiated in April 1985 under DOE's Byproducts Utilization Program, with the objectives of transferring food irradiation technology to the industry and thereby demonstrating a beneficial use for the 137 Cs nuclear by-product isotope. As designed, CACI will meet the intended requirements for research, development, and demonstration of irradiation processing of food. Further, as shown in the safety analyses performed during the project, the design conforms to all the safety and licensing requirements set forth for the project. The original scope of the CACI project included completion of its construction. However, the project was terminated for the convenience of the government during the final design phase in February 1986 for lack of a specific site. The CACI final design is described in eight volumes. This volume Volume III, describes the Shielding Window.

4300 (CNEN-DIN–04/83) **Bibliographic review of works accomplished about irradiated chicken, fish and fish products , spices and condiments.** Bernardes, B.; Dias Filho, M. Comissao Nacional de Energia Nuclear (CNEN), Rio de Janeiro, RJ (Brazil). Dept. de Instalacoes e Materiais Nucleares. Jul 1983. 45p. (In Portuguese). Order Number DE93607296. Source: OSTI; NTIS (US Sales Only); INIS.

Table of foods that can be irradiated and its respective nominal doses are shown. Bibliographic reviews of works performed about irradiated chicken, fish and fish products, spices and condiments are shown. The irradiation purpose in chicken were to increase the shelf-life and to eliminate the pathogenic microorganism in chicken stored below 10^0 C; in fish and fish products the purposes were to control the insect infestation in dry-fish during the storage and the sell exposure to reduce the macrobian charge in packed and non packed fish and in fish products. To reduce pathogenic microorganism in packing and unpacking fish; in spices and condiments to control the insect infestation, to reduce the microbial contamination. (L.M.J.).

4301 (CONF-9109358–, pp. 19) **Aflatoxigenic isolates of Aspergillus flavus naturally contaminating common feedstuff in Jordan and suitability of some feed as natural substrates for aflatoxin production.** Natour, R.M. (University of Jordan, Amman (Jordan)); Rabba, J.A.A.; Salhab, A. USDOE, Washington, DC (United States). [1991]. From 8. international conference on chemistry for protection of the environment; Lublin (Poland); 16-18 Sep 1991. In *Chemistry for protection of the environment, Eight international conference: Proceedings.* 635p. Order Number DE92014317. Source: OSTI; NTIS; INIS.

This work was carried out on 249 samples of different feedstuffs, commonly used in different dairy farms in Jordan, to investigate their natural contamination with aflatoxigenic isolates of A. flavus group. The suitability of some feeds as natural substrates for aflatoxin production, with special reference to type and quantity of produced aflatoxins were also studied. On the basis of microscopic and morphological identification, isolates of A. flavus group were found in 47.4% of the various feedstuffs examined. Twenty two percent of these isolates were aflatoxigenic. Most of these toxigenic isolates (76.9%) showed the ability to produce both aflatoxins B_1 and B_2, under laboratory conditions; some of them (23.1%) produced only aflatoxin B_1; but none produced the G-type aflatoxin. Out of 7 different feedstuffs tested for their suitability as natural substrates for aflatoxin production, only 5 samples were found to support the production aflatoxins by A. parasiticus NRRL 2999, but at low levels. These samples were four types of concentrate and waste feedstuffs were low, still they represent a potential health hazard, specially when such feedstuffs are stored for a long period of time.

4302 (IAEA-NAHRES–3, pp. 15.1) **Removal of radioiodine and other radionuclides from vegetables, rice and milk.** Muramatsu, Y. (National Inst. of Radiological Sciences, Nakaminato, Ibaraki (Japan)); Sumiya, M.; Ohmomo, Y. International Atomic Energy Agency, Vienna (Austria). Section of Nutritional and Health-Related Environmental Studies. 1990. (CONF-8911339–: 3. research co-ordination meeting on nuclear techniques for toxic elements in foodstuffs, Jakarta (Indonesia), 20 Nov 1989). In *Co-ordinated research programme on nuclear techniques for toxic elements in foodstuffs: Report on the third research co-ordination meeting, Jakarta, Indonesia, 20-24 November 1989.* 184p. Order Number DE93606507. Source: OSTI; NTIS (US Sales Only); INIS.

Short communication. JAPAN/local fallout; MILK/decontamination; RICE/decontamination; VEGETABLES/decontamination; CESIUM ISOTOPES; CHERNOBYLSK-4 REACTOR; IODINE ISOTOPES; JAPAN; MILK; DECONTAMINATION; RICE; TRACER TECHNIQUES; TRANSFRONTIER CONTAMINATION; VEGETABLES; WASHING

4303 (IAEA-NAHRES–8) **Co-ordinated research programme applications of stable isotope tracers in human nutrition research: Report on the second research co-ordination meeting Bangalore, India, 26-29 November 1990.** International Atomic Energy Agency, Vienna (Austria). Section of Nutritional and Health-Related Environmental Studies. 1992. 130p. (CONF-9011308–: 2. research co-ordination meeting on applications of stable isotope tracers in human nutrition research, Bangalore (India), 26-29 Nov 1990). Order Number DE93607313. Source: OSTI; NTIS (US Sales Only); INIS.

The objective of this Co-ordinated Research Programme is to help establish competence in the use of stable isotope techniques, particularly in developing countries. This report summarizes the discussions that took, place during the Second Research Co-ordination Meeting, held in Bangalore in November 1990. Working papers presented by the participants are included as annexes. Refs, figs and tabs.

4304 (IAEA-NAHRES–8, pp. 10.1-10.13) **Protein metabolism in Papua New Guinea: A study using stable isotopes.** Brown, T. (Papua New Guinea Inst. of Medical Research, Mandang (Papua New Guinea)). International Atomic Energy Agency, Vienna (Austria). Section of Nutritional and Health-Related Environmental Studies. 1992. Contract 5192. (CONF-9011308–: 2. research co-ordination meeting on applications of stable isotope tracers in human nutrition research, Bangalore (India), 26 Nov 1990). In *Co-ordinated research programme applications of stable isotope tracers in human nutrition research: Report on the second research co-ordination meeting Bangalore, India, 26-29 November 1990.* 130p. Order Number DE93607313. Source: OSTI; NTIS (US Sales Only); INIS.

Adult Papua New Guineans have low intakes of energy, protein and other nutrients, but they appear physically well developed and show no signs of malnutrition. It appears that a number of adaptive mechanisms are at work, but it is desirable to repeat the experiments under more controlled conditions. This project is designed to investigate the nitrogen balance and protein turnover of coastal Papua New Guineans consuming different diets. 22 refs.

4305 (IAEA-NAHRES–8, pp. 11.1-11.6) **Application of ^{15}N amino acid absorption in chronic enteropathy and hepatic diseases in infants.** Palibroda, N. (Institutul de Tehnologie Izotopica si Moleculara, Cluj-Napoca (Romania)); Culea, M.; Chiriac, M.; Miu, N. International Atomic Energy Agency, Vienna (Austria). Section of Nutritional and Health-Related Environmental Studies. 1992. Contract 5193. (CONF-9011308–: 2. research co-ordination meeting on applications of stable isotope tracers in human nutrition research, Bangalore (India), 26 Nov 1990). In *Co-ordinated research programme applications of stable isotope tracers in human nutrition research: Report on the second research co-ordination meeting Bangalore, India, 26-29 November 1990.* 130p. Order Number DE93607313. Source: OSTI; NTIS (US Sales Only); INIS.

The aim of this work is to compare the distribution of N-15 (derived from ^{15}N-glycine) between body fluids of infants in healthy subjects and in subjects suffering from intestinal malabsorption. The data obtained so far support the idea that the malabsorption group has lower ^{15}N elimination in urine and higher elimination in faeces. 5 refs, 5 tabs.

4306 (IAEA-NAHRES–8, pp. 12.1-12.3) **Support for studies with doubly labelled water of adaptation in human energy needs in India, Malaysia and Mexico.** Haggarty, P. (Rowett Research Inst., Aberdeen (United Kingdom)). International Atomic Energy Agency, Vienna (Austria). Section of Nutritional and Health-Related Environmental Studies. 1992. Contract 5371. (CONF-9011308–: 2. research co-ordination meeting on applications of stable isotope tracers in human nutrition research, Bangalore (India), 26 Nov 1990). In *Co-ordinated research programme applications of stable isotope tracers in human nutrition research: Report on the second research co-ordination meeting Bangalore, India, 26-29 November 1990.* 130p. Order Number DE93607313. Source: OSTI; NTIS (US Sales Only); INIS.

This study aims to address adaptation to low energy intakes by metabolic/behavioural means or via the effects of chronic undernutrition on body composition. The outcome will be of great importance in the verification and refinement of the WHO/FAO/UNU equations for the prediction of energy needs in developing countries.

4307 (IAEA-NAHRES–8, pp. 13.1-13.3) **Synthesis of ^{13}C labelled lactose for metabolic studies.** Moyna, P. (Facultad de Quimica, Montevideo (Uruguay)). International Atomic Energy Agency, Vienna (Austria). Section of Nutritional and Health-Related Environmental Studies. 1992. Contract 5372. (CONF-9011308–: 2. research co-ordination meeting on applications of stable isotope tracers in human nutrition research, Bangalore (India), 26 Nov 1990). In *Co-ordinated research programme applications of stable isotope tracers in human nutrition research: Report on the second research co-ordination meeting Bangalore, India, 26-29 November 1990.* 130p. Order Number DE93607313. Source: OSTI; NTIS (US Sales Only); INIS.

The most common cause of diarrhoea in Uruguay is lactose intolerance, and to determine the origin of diarrhoea in individual cases a deep and fast clinical method is highly desirable. The present report discusses the synthesis of c-13-labelled lactose and two separation methods for detecting sugars in samples of faeces.

4308 (IAEA-NAHRES–8, pp. 14.1-14.7) **Reference materials and evaluation of the precision and accuracy of the DLW method.** Haggarty, P. (Rowett Research Inst., Aberdeen (United Kingdom)). International Atomic Energy Agency, Vienna (Austria). Section of Nutritional and Health-Related Environmental Studies. 1992. (CONF-9011308–: 2. research co-ordination meeting on applications of stable isotope tracers in human nutrition research, Bangalore (India), 26 Nov 1990). In *Co-ordinated research programme applications of stable isotope tracers in human nutrition research: Report on the second research co-ordination meeting Bangalore, India, 26-29 November 1990.* 130p. Order Number DE93607313. Source: OSTI; NTIS (US Sales Only); INIS.

This report describes a simple test of the accuracy of the doubly-labelled water method for calculation of carbon dioxide production. 1 ref., 4 figs.

4309 (IAEA-NAHRES–8, pp. 15.1-15.2) **Hepatic protein metabolism in man.** Klein, P.D. (Children's Nutrition Research Center, Houston (United States)). International Atomic Energy Agency, Vienna (Austria). Section of Nutritional and Health-Related Environmental Studies. 1992. (CONF-9011308–: 2. research co-ordination meeting on applications of stable isotope tracers in human nutrition research, Bangalore (India), 26 Nov 1990). In *Co-ordinated research programme applications of stable isotope tracers in human nutrition research: Report on the second research co-ordination meeting Bangalore, India, 26-29 November 1990.* 130p. Order Number DE93607313. Source: OSTI; NTIS (US Sales Only); INIS.

Apolipoprotein-B100 circulating in the very low density lipoprotein particles has a very rapid turnover rate and is almost exclusively of hepatic origin. It thus provides a direct index of the isotopic enrichment of the hepatic amino acids from which plasma proteins are derived.

4310 (IAEA-NAHRES–8, pp. 3.1-3.10) **Prognostic significance of protein-calorie malnutrition in post-virus hepatitis cirrhosis and the design of diet therapy based on Chinese food using isotope tracers.** Xia Zongqin (Shanghai Medical Univ., SH (China)). International Atomic Energy Agency, Vienna (Austria). Section of Nutritional and Health-Related Environmental Studies. 1992. Contract 5189. (CONF-9011308–: 2. research co-ordination meeting on applications of stable isotope tracers in human nutrition research, Bangalore (India), 26 Nov 1990). In *Co-ordinated research programme applications of stable isotope tracers in human nutrition research: Report on the second research co-ordination meeting Bangalore, India, 26-29 November 1990.* 130p. Order Number DE93607313. Source: OSTI; NTIS (US Sales Only); INIS.

This document reports studies of the metabolism of patients with post-viral hepatitis cirrhosis. Three separate areas are investigated by means of tracer techniques: whole-body protein synthesis and breakdown; energy expenditures; and protein turnover and leucine oxidation. 12 refs, 8 tabs.

4311 (IAEA-NAHRES–8, pp. 4.1-4.10) **Metabolic tracer studies with nitrogen-15 in children.** Jung, K. (Federal Research Centre Leipzig-Halle, Leipzig (Germany)); Krumbiegel, P.; Faust, H. International Atomic Energy Agency, Vienna (Austria). Section of Nutritional and Health-Related Environmental Studies. 1992. Contract 5190. (CONF-9011308–: 2. research co-ordination meeting on applications of stable isotope tracers in human nutrition research, Bangalore (India), 26 Nov 1990). In *Co-ordinated research programme applications of stable isotope tracers in human nutrition research: Report on the second research co-ordination meeting Bangalore, India, 26-29 November 1990.* 130p. Order Number DE93607313. Source: OSTI; NTIS (US Sales Only); INIS.

This paper reports the results of metabolic studies on children, performed using N-15 tracer techniques. Separate experiments described address studies of liver function, diagnosis of gastric Helicobacter pylori infections and investigations of the metabolic effects of recombinant human growth hormone on Turner Syndrome girls. 9 refs, 8 figs.

4312 (IAEA-NAHRES–8, pp. 5.1-5.18) **Energy-protein requirements and adaptation during nutritional recovery.** Vasquez-Velasquez, L. (INCAP, Guatemala City (Guatemala)); Peres, J.M.; Nitsch, A.; Bulux, J.; Melgar, S. de; Prentice, A. International Atomic Energy Agency, Vienna (Austria). Section of Nutritional and Health-Related Environmental Studies. 1992. Contract 5451. (CONF-9011308–: 2. research co-ordination meeting on applications of stable isotope tracers in human nutrition research, Bangalore (India), 26 Nov 1990). In *Co-ordinated research programme applications of stable isotope tracers in human nutrition research: Report on the second research co-ordination meeting Bangalore, India, 26-29 November 1990.* 130p. Order Number DE93607313. Source: OSTI; NTIS (US Sales Only); INIS.

Malnutrition is one of the world's most widely prevalent pathological conditions that affects people of all ages. The detrimental effects of malnutrition often become evident in children, in whom both physical and mental development are compromised. The present paper reports preliminary results of a project to asses the protein and energy requirements for nutritional recovery. It is also planned to investigate the adaptive mechanisms resulting from chronic low food intake in severely malnourished children. 12 refs, 2 figs, 7 tabs.

4313 (IAEA-NAHRES–8, pp. 6.1-6.12) **Studies with doubly-labelled water of adaptation in humans.** Shetty, P.S. (St. John's Medical College, Bangalore (India). Nutrition Research Centre). International Atomic Energy Agency, Vienna (Austria). Section of Nutritional and Health-Related Environmental Studies. 1992. Contract 5368. (CONF-9011308–: 2. research co-ordination meeting on applications of stable isotope tracers in human nutrition research, Bangalore (India), 26 Nov 1990). In *Co-ordinated research programme applications of stable isotope tracers in human nutrition research: Report on the second research co-ordination meeting Bangalore, India, 26-29 November 1990.* 130p. Order Number DE93607313. Source: OSTI; NTIS (US Sales Only); INIS.

Preliminary studies are presented addressing the effects of short-term energy supplementation of undernourished subjects, and a series of experiments to investigate the relationship between "food quotients" and "respiratory quotients" and the use of these quotients to calculate free living energy expenditure is also reported. The observation, although preliminary, raise important technical problems relating to the methods used for converting CO_2 production rate to total energy expenditure. 10 refs.

4314 (IAEA-NAHRES–8, pp. 7.1-7.12) **Energy needs of lactating mothers and breast-feeding children in Senegal.** Ferro Luzzi, A. (Istituto Nazionale della Nutrizione, Rome (Italy)); Chevassus Agnes, S.; Borne Godeluck, M.M.; Yameogo, P.; Ndiaye, A.M. International Atomic Energy Agency, Vienna (Austria). Section of Nutritional and Health-Related Environmental Studies. 1992. Contract 5833/5834. (CONF-9011308–: 2. research co-ordination meeting on applications of stable isotope tracers in human nutrition research, Bangalore (India), 26 Nov 1990). In *Co-ordinated research programme applications of stable isotope tracers in human nutrition research: Report on the second research co-ordination meeting Bangalore, India, 26-29 November 1990.* 130p. Order Number DE93607313. Source: OSTI; NTIS (US Sales Only); INIS.

This project aims to use isotopic techniques to measure energy expenditure and breast milk intake of children, and the energy expenditure and breast milk production of lactating mothers. Two separate methods are being used, both of which involve the use of doubly labelled water. The present report presents growth rate date on the children and data on how they spend their time; the isotopic analysis has not yet been performed. 5 refs, 5 tabs.

4315 (IAEA-NAHRES–8, pp. 8.1-8.5) **Studies with doubly-labelled water of adaptation in human energy needs in Malaysia.** Mohd Ismali Noor (Department of Food Science and Nutrition Bangi, Selangor (Malaysia)). International Atomic Energy Agency, Vienna (Austria). Section of Nutritional and Health-Related Environmental Studies. 1992. Contract 5369. (CONF-9011308–: 2. research co-ordination meeting on applications of stable isotope tracers in human nutrition research, Bangalore (India), 26 Nov 1990). In *Co-ordinated research programme applications of stable isotope tracers in human nutrition research: Report on the second research co-ordination meeting Bangalore, India, 26-29 November 1990.* 130p. Order Number DE93607313. Source: OSTI; NTIS (US Sales Only); INIS.

The basal metabolic rates of 42 adult males (Malay, Chinese and Indians) have been calculated from measurements of oxygen concentration and volume of expired air. Further experiments will use doubly-labelled water to evaluate the total daily energy expenditure of Malaysians. 5 refs, 3 tabs.

4316 (IAEA-NAHRES–8, pp. 9.1-9.10) **The effect of continuous work on discretional energy expenditure in male adult construction workers in northern Mexico.** Valencia, M.E. (Centro de Investigacion y Desarollo, A.C. Hermosillo Sonora (Mexico)); Haggarty, P.; McNeill, G.; Gonzales, L.; Moya, S.; Saucedo, S.; Esparza, J.; Pinelli, A. International Atomic Energy Agency, Vienna (Austria). Section of Nutritional and Health-Related Environmental Studies. 1992. Contract 5370. (CONF-9011308–: 2. research co-ordination meeting on applications of stable isotope tracers in human nutrition research, Bangalore (India), 26 Nov 1990). In *Co-ordinated research programme applications of stable isotope tracers in human nutrition research: Report on the second research co-ordination meeting Bangalore, India, 26-29 November 1990.* 130p. Order Number DE93607313. Source: OSTI; NTIS (US Sales Only); INIS.

The objective of this study is to measure the variations in discretional energy expenditure in male adult construction workers of different body mass index when exposed to a heavy and prolonged workload. It is also intended to compare the factorial method based on indirect calorimetry with the doubly-labelled water system for the estimation of free living energy expenditure. 15 refs, 5 tabs.

4317 (IAEA-NAHRES–10) **Co-ordinated research programme on applications of stable isotope tracers in human nutrition research: Report on the third research co-ordination meeting Houston, Texas, USA, 6-9 April 1992.** International Atomic Energy Agency, Vienna (Austria). Section of Nutritional and Health-Related Environmental Studies. 1992. 30p. (CONF-9204199–: 3. research co-ordination meeting on applications of stable isotope tracers in human nutrition research, Houston, TX (United States), 6-9 Apr 1992). Order Number DE93607312. Source: OSTI; NTIS (US Sales Only); INIS.

This document provides a very brief report on the final Research Co-ordination Meeting of this Co-ordinated Research Project (CRP): the final report on the CRP will be published by the IAEA in the IAEA-TECDOC series. The present document contains a detailed proposal for a new Co-ordinated Research Programme on "Stable Isotope Tracer Techniques for Studies on Protein-Energy Interactions", and a brief series of notes on stable isotopic methods for investigating protein and amino-acid metabolism in man. Refs.

4318 (INIS-BR–2957) **Standardization of human thyrotropin radioimmunoassay and its application to the purification of this hormone to the preparation of the assay reagents.** Lin, L.H. Instituto de Pesquisas Energeticas e Nucleares (IPEN), Sao Paulo, SP (Brazil). 1991 168p. (In Portuguese). Order Number DE93607314. Source: OSTI; NTIS (US Sales Only); INIS.

The various steps that are necessary for setting up the thyrotropin radioimmunoassay are presented below. Radioiodination was carried out through the Chloramine T method and the labeled purification performed on Sephadex G-100. Purification of human thyrotropin from side fractions obtained during the purification of growth hormone was carried out in order to obtain a pure reagent for use in the radioimmunoassay. The employment of the hormone obtained was evaluated as the radioimmunoassay tracer in comparison with that prepared from the hormone received from the NIDDKD, U.S.A. The results indicated that although it was not possible to obtain a hormone with a purity degree adequate to be used as the tracer, enough experience was acquired for the isolation of thyrotropin. (author).

4319 (INIS-BR–3007) **Effect of the histaminergic antagonist over the pulmonary oedema growth in P. berghei - infected mice.** Martins, M.A. Universidade do Estado, Rio de Janeiro, RJ (Brazil). Centro Biomedico. 1985 75p. (In Portuguese). Order Number DE93607315. Source: OSTI; NTIS (US Sales Only); INIS.

The involvement of histaminergic mechanisms in the pathogenesis of pulmonary oedema observed in p. berghei - infected mice was investigated. Histamine concentrations in plasma and whole blood of infected and normal mice were determined by radioenzymatic assay during the seven days of the infection. Elevated plasma and whole blood histamine levels were found at the last stages of infection (sixth day and seventh day) after intraperitoneal injection of parasitized erythrocytes, showing a close temporal correlation between the development of the oedema and the elevation of the circulating histamine concentrations. The participation of H 1 and H 2 receptors in the increase in vascular permeability (IVP) induced by histamine was also verified. (author).

4320 (INIS-BR–3022) **The concentrations of ^{226} Ra and ^{210} Pb in food cultivated in Pocos de Caldas.** Hollanda Vasconcellos, L.M. de. Universidade do Estado, Rio de Janeiro, RJ (Brazil). Centro Biomedico. 1984 104p. (In Portuguese). Order Number DE93607297. Source: OSTI; NTIS (US Sales Only); INIS.

The aim of this study is to determine the average concentrations of ^{226} Ra and ^{210} Pb in vegetables widely cultivated in the region, mainly potatoes, carrots, beans and corn which are the main agricultural products (considering production and human consume) in the region and estimation of the average transfer factors soil-foodstuff for both radionuclides. The total ^{226} Ra and ^{210} Pb content in the soil was determined by gamma spectrometry. The exchangeable fraction was obtained by ammonium acetate solution extraction. The ^{226} Ra was analysed by the classical radon emanation procedure and the ^{210} Pb was isolated by a radiochemical procedure and determined by radiometry of its daughter ^{210} Bi beta emissions with a Geiger Mueller counter. (author).

4321 (INIS-mf–13375, pp. 51) **The activities of the department of application of radioisotopes in agriculture Tehran, for 1983.** Naghedi-Ahmadi, I.; Alemzadeh, M. Tajoura Nuclear Research Centre, Tripoli (Libyan Arab Jamahiriya). 1984. 82p. (CONF-8409421–: Seminar on the use of research reactors in fundamental and applied sciences, Tajoura (Libyan Arab Jamahiriya), 16 Sep 1984). In *Seminar on the use of research reactors in fundamental and applied sciences. Programme and abstracts.* Order Number DE93606515. Source: Also available from Tajoura Nuclear Research Centre, Tajoura/Tripoli, Libya.

Short communication. RADIOISOTOPES/agriculture; PLANT BREEDING; RADIOISOTOPES; AGRICULTURE

56 BIOMEDICAL SCIENCES, APPLIED STUDIES

5601 Radiation Effects

Refer also to citation(s) 2660, 2661, 2664, 2670, 2697, 2733, 2844, 3005, 3082, 3097, 3152, 3313, 3487, 3488, 4145, 4214, 4261, 4285, 4384, 4786

4322 (AECS-PR/RSS–42) **Radioactive contamination and decontamination procedures.** Othman, Ibrahim (Atomic Energy Commission, Damascus (Syrian Arab Republic)); Ali, A.F.; Kheitou, M. Atomic Energy Commission, Damascus (Syrian Arab Republic). Jun 1992. 33p. (In Arabic). Order Number DE93607349. Source: OSTI; NTIS (US Sales Only); INIS.

This report presents sources, types, nature and classification of radioactive contamination. It also cover the protection procedures for decontamination. It is inevitable to understand the sources and processes of contamination to remove it effectively. (author). 11 refs., 11 tabs.

4323 (DOE/ER/60417–006) **Fast neutron dosimetry: Progress report, 1 July 1991–1 September 1992.** DeLuca, P.M. Jr.; Pearson, D.W. Wisconsin Univ., Madison, WI (United States). Dept. of Medical Physics. [1992]. 85p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG02-86ER60417. Order Number DE93003659. Source: OSTI; NTIS; INIS; GPO Dep.

This progress report concentrates on two major areas of dosimetry research: measurement of fast neutron kerma factors for several elements for monochromatic and white spectrum neutron fields and determination of the response of thermoluminescent phosphors to various ultra-soft X-ray energies and beta-rays. Dr. Zhixin Zhou from the Shanghai Institute of Radiation Medicine, People's Republic of China brought with him special expertise in the fabrication and use of ultra-thin TLD materials. Such materials are not available in the USA. The rather unique properties of these materials were investigated during this grant period.

4324 (DOE/ER/60455–T4) **Mechanisms for radiation damage in DNA: Progress report, June 1, 1992–May 31, 1993.** Sevilla, M.D. Oakland Univ., Rochester, MI (United States). Dec 1992. 10p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG02-86ER60455. Order Number DE93003715. Source: OSTI; NTIS; GPO Dep.

In this project we have proposed several mechanisms for radiation damage and recently radiation protection to DNA and its constituents, and have detailed a series of experiments utilizing electron spin resonance spectroscopy, HPLC, GC-mass spectroscopy and ab initio molecular orbital calculations to test the proposed mechanisms. In this years work we have performed experiments which elucidate the role of hydration water on DNA radiation damage, continued the investigation of the localization of the initial charges on DNA and employed ab initio molecular orbital theory to gain insight into the initial events of radiation damage to DNA. Ab initio calculations have provided an understanding of the energetics envolved in anion and cation formation, ion radical transfer in DNA as well as proton transfer with DNA base pair radical ions. This information has aided the formation of new radiation models for the effect of radiation on DNA. During this fiscal year four articles have been published, two are in press, two are submitted and several more are in preparation. Six papers have been presented at scientific meetings. This years effort includes a review article on the "Chemical Consequences of Radiation Damage to DNA". This review presents an overview of this field at this time.

4325 (DOE/ER/60464–6) **Direct assay of radiation-induced DNA base lesions in mammalian cells: Technical progress report, November 1, 1989–September 1, 1992.** Bowman Gray School of Medicine, Winston-Salem, NC (United States). [1992]. 7p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG05-86ER60464. Order Number DE93001832. Source: OSTI; NTIS; INIS; GPO Dep.

Adenine (Ade), 2'-deoxyadenosine (dAdo), 5'-deoxyadenosine monophosphate (dAUT), single stranded poly adenylic acid [poly (dA)], double stranded deoxyadenylic-thymidylic acid [ds poly (dA-T)] and salmon testis DNA were irradiated with 500 Gy under oxic and anoxic conditions. The major damage products were analyzed by BPLC with optical detection and quantitated in terms of the percentage of the adenosine in each model compound found as a specific damage product. Outside of the Ade free base, 8-OH-dAdo was the major oxic damage product from each model compound. The type and quantity of the major damage products depended on the sequence and conformation of the model compounds under anoxic conditions. When dAdo and dAMP were irradiated under anoxic conditions, the major damage product was either the R or S isomer of 8,5'cdAdo and little Ade or α-dAdo was observed. However, when poly(dA), poly(dA-dT), and salmon testis DNA were γ-irradiated under nitrogen, the major deoxyadenosine damage product was identified as the α-anomer of deoxyadenosine. No α-deoxyadenosine was detected after irradiation under oxic conditions. The presence of nucleotides with the α-configuration at the anomeric carbon atom in the DNA chain may have a significant effect on its tertiary structure and possibly modify its biological activity.

4326 (DOE/ER/60533–5) **The study of human mutation rates: Progress report, 1989–1992.** Neel, J.V. Michigan Univ., Ann Arbor, MI (United States). [1992]. 33p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG02-87ER60533. Order Number DE93003658. Source: OSTI; NTIS; INIS; GPO Dep.

We will describe recent developments regarding the question of induced mutations in the survivors of the atomic bombings of Hiroshima and Nagasaki. As part of that work we, describe some developments with respect to the Amerindian blood samples collected under DoE sponsorship between 1964 and 1982. Then developments regarding the application of two-dimensional polyacrylamide gel electrophoresis (2-D PAGE) to the study of genetic variation and mutation affecting protein characteristics. In particular, we will report on the identification and isolation of genes of especial interest as reflected in the behavior of the proteins which they encode.

4327 (DOE/ER/60668–5) **Radon: Chemical and physical processes associated with its distribution: Annual progress report.** Castleman, A.W. Jr. Pennsylvania State Univ., University Park, PA (United States). Dept. of Chemistry. [1992]. 5p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG02-88ER60668. Order Number DE93003718. Source: OSTI; NTIS; INIS; GPO Dep.

Assessing the mechanisms which govern the distribution, fate, and pathways of entry into biological systems, as well as the ultimate hazards associated with the radon progeny and their secondary reaction products, depends on knowledge of their chemistry. Our studies are directed toward developing fundamental information which will provide a basis for modeling studies that are requisite in obtaining a complete picture of growth, attachment to aerosols, and transport to the bioreceptor and ultimate incorporation within. Our program is divided into three major areas of research. These include measurement of the determination of their mobilities, study of the role of radon progeny ions in affecting reactions, including study of the influence of the degree of solvation (clustering), and examination of the important secondary reaction products, with particular attention to processes leading to chemical conversion of either the core ions or the ligands as a function of the degree of clustering.

4328 (DOE/ER/61085–2) **[Nanometer scale exciton spectroscopy and photochemistry: Dynamic imaging of DNA structure-activity relations and radiation signatures]: Progress report, July 25, 1991–September 30, 1992.** Michigan Univ., Ann Arbor, MI (United States). [1992]. 3p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG02-90ER61085. Order Number DE93003341. Source: OSTI; NTIS; INIS; GPO Dep.

Our aim is to investigate, on the molecular level at a spatially resolved mode of operation, structure-activity relations of DNA and their sensitivity to ionizing radiation. This entails in-vitro (and later in-vivo) ultra-resolved microscopy, spectroscopy and chemical sensing, with non-destructive probing.

4329 (DOE/RW–0362-TG) **Science, society, and America's nuclear waste: Unit 2, Ionizing radiation: Teacher guide.** USDOE Office of Civilian Radioactive Waste Management, Washington, DC (United States). [1992]. 169p. Sponsored by USDOE, Washington, DC (United States). Source: OSTI (Free of Charge); INIS.

"Science, Society and America's Nuclear Waste" is a four-unit secondary curriculum. It is intended to provide information about scientific and societal issues related to the management of spent nuclear fuel from generation of electricity at nuclear powerplants and high-level radioactive waste from US national defense activities. The curriculum, supporting classroom activities, and teaching materials present a brief discussion of energy and electricity generation, including that produced at nuclear powerplants; information on sources, amounts, location, and characteristics of spent nuclear fuel and high-level radioactive waste; sources, types and effects of radiation; US policy for managing and disposing of spent nuclear fuel and high-level radioactive waste and what other countries are doing; and the components of the nuclear waste management system.

4330 (INIS-BR–2958) **Theoretical-experimental study of the non-thermal effects of the polarized laser radiation in living tissues.** Ribeiro, M.S. Instituto de Pesquisas Energeticas e Nucleares (IPEN), Sao Paulo, SP (Brazil). 1991 116p. (In Portuguese). Order Number DE93607212. Source: OSTI; NTIS (US Sales Only); INIS.

In the present research we had as a fundamental objective to analyse the non-thermal effects of the laser polarized light in biological tissues. These effects were performed with low power laser output. The theoretical procedure consisted in looking for a simple model which connects the effect of light polarized with microscopically rough tissues using well established physical concepts. Experimentally, we created artificial wounds on the back of animals using liquid nitrogen (this method was chosen because it does not interfere in the biochemistry of the animal tissue). For the wound irradiation we have utilized a He-Ne attached to an optical system. (author).

4331 (INIS-BR–2959) **Internal contamination by natural uranium: monitoring by analysis of urine of individuals exposed by occupational inhalation.** Ramalho, A.T. Universidade do Estado, Rio de Janeiro, RJ (Brazil). Centro Biomedico. 1982 132p. (In Portuguese). Order Number DE93607261. Source: OSTI; NTIS (US Sales Only); INIS.

Urine samples from men working at Usina Santo Amaro (USAM - State of Sao Paulo), a monazite refinery, were analysed for uranium concentration, using fluorometric analysis and alpha spectrometry. All samples analysed presented uranium concentration below the lower limit of detection. Theoretical values were calculated for uranium concentration in urine samples from workers at the annual limit of intake (ALI) for inhalation of natural uranium, recommended in Publication 30 of the International Commission on Radiological Protection (ICRP, 1979). The two different methods used for analysis of natural uranium concentration in the urine samples were compared: fluorimetry and alpha spectrometry. (author).

4332 (INIS-BR–2960) **Lethal effects of solar radiation in proficient and deficient bacteria in repair systems.** Sousa Neto, A. de. Universidade do Estado, Rio de Janeiro, RJ (Brazil). Centro Biomedico. 1980 79p. (In Portuguese). Order Number DE93607205. Source: OSTI; NTIS (US Sales Only); INIS.

A study of the lethal action of solar radiation on strains of E.coli K12, proficient or deficient in repair systems, as well as the wild type strain gene products are involved in repair of damage induced by solar radiation. The inactivation of the various bacterial strains (normalized to a dose equivalent to radiation at a wavelength 254 nm) suggests that the more energetic wavelengths of the solar spectrum (290-320 nm) could be responsible for the primary damage that occurs in the DNA. The reduction in the shoulder of the survival curve in wild type strains in indicative of induction of sub-lethal damage in this region of the curve. Analysing solar inactivation curves of the bacterial strains (normalised by spore dosimetry) together with those of the same strains irradiated with UV at 254 nm, it was evident that 254 nm is not the ideal wavelength for comparison. This analysis also indicated that in addition to damage to DNA, other factors are involved in the solar radiation inactivation of wild type strains. (author).

4333 (INIS-BR–2961) **Lysogenic induction in Lex AI Escherichia coli mutants: characterization of the induction and prophage repressor influence.** Carvalho, R.E.S. Universidade do Estado, Rio de Janeiro, RJ (Brazil). Centro Biomedico. 1982 84p. (In Portuguese). Order Number DE93607206. Source: OSTI; NTIS (US Sales Only); INIS.

SOS functions require new synthesis of protein and have been described as dependent on both the rec A and lex A genes. The induction of prophage was studied in bacterial strains lysogenic for a series of phages which synthesize different levels of repressor (λ, λ_{imm434} and λ_{imm434}) and was compared to W-reactivation. Prophage induction was detected in lex AI mutants although at a slightly lower level and requiring two times longer when compared with wild-type. The optimum UV-dose for induction differed for each lysogenic strain and correlated with the level of repressor.

4334 (INIS-BR–2962) **Study of the thorium incorporation by inhalation in individuals occupationally exposed.** Holanda e Vasconcellos Carvalho, B. de. Universidade do Estado, Rio de Janeiro, RJ (Brazil). Centro Biomedico. 1983 215p. (In Portuguese). Order Number DE93607366. Source: OSTI; NTIS (US Sales Only); INIS.

A mathematical model describing the metabolism of inhaled thorium in the human body was developed. Through this model theoretical limits of excretion were calculated for workers of a monazite plant (Usina Santo Amaro). This limits were based on International Commission on Radiological Protection publication 30, 1979. Excreta samples from twelve workers of Usina Santo Amaro were collected and analysed for thorium. All samples were bellow the theoretical limits of excretion indicating that Usina Santo Amaro workers are exposed to thorium levels bellow the Annual Limits of Intake recommended by ICRP, publication 30. (author).

4335 (INIS-BR–2967) **Dominant lethal mutations research in mice fed with irradiated black beams.** Andrade, Z.P. Universidade do Estado, Rio de Janeiro, RJ (Brazil). Inst. de Biologia. 1982 63p. (In Portuguese). Order Number DE93607213. Source: OSTI; NTIS (US Sales Only); INIS.

To evaluate the potential mutagenic effects of irradiated black beans (Phaseolus vulgaris) with conservation purpose, in germ cells of mice, dominant lethal assay were employed. Three groups of albino swiss male mice (S W-55) were fed with a normal ration, or unirradiated or irradiated (0,2; 0,5; 1; 5; 10; 15 e 20 KGy) test diets for eight weeks. After the feeding period the males were mated with groups of untreated females mice for four consecutive weeks. Numbers of pregnancy rates females were observed. The females were autopsied at mid-term pregnancy for evaluation of dominant lethal mutations. (author).

4336 (INIS-BR–2981) **Personnel neutron monitoring based on albedo technique.** Carvalho, W.B.D. de. Instituto Militar de Engenharia (IME), Rio de Janeiro, RJ (Brazil). 1975 88p. (In Portuguese). Order Number DE93607367. Source: OSTI; NTIS (US Sales Only); INIS.

This work deals with the study, design and test of a personal neutron monitor based on the detection of albedo neutrons from the body and its further relation to the incident flux. By this method, neutrons of energies below about 100 KeV can be efficiently detected, providing good information in the region where the biological effectiveness of neutron radiation starts to rise. The system consists of a pair of Thermoluminescent Detectors (^{6} LiF - ^{7} LiF) $\approx$ inside a polyethylene moderating body, in order to increase the sensitivity. The surface of the dosimeter facing away from the body is covered by a layer of a borated resin to assure appropriate shielding of incident low energy neutrons. The response of the dosimeter to monoenergetic neutrons from a 3 MeV Van de Graaff, to Am Be neutrons and to neutrons from a thermal column was investigated. The directional sensitivity, the effect of beam divergence was well as the effect of changes in dosimeter-to-body distances were also studied. (author).

4337 (INIS-BR–2986) **Effect of ^{60} Co gamma radiation on crystalline proteins.** Bernardes, D.M.L. Instituto de Pesquisas Energeticas e Nucleares (IPEN), Sao Paulo, SP (Brazil). 1991 67p. (In Portuguese). Order Number DE93607199. Source: OSTI; NTIS (US Sales Only); INIS.

In order to study the effects of ^{60} Co gamma radiation on crystalline proteins an in vitro system was set up. For that, aqueous solutions from bovine crystalline were used irradiated with 0, 5.000, 10.000, 15.000, 20.000 and 25.000 Gy. The treatment led to protein alterations determined by different methods. By turbidimetry the formation of aggregates that increased with the radiation dose was revealed. The same observation was done from viscosity data and from the UV spectrum of the samples. From amino acid analysis and fluorimetry determinations, tryptophan appeared as the most sensitive amino acid. An increase in the free-S H-groups was also observed. After the standardization of the method, the radio modifier capability of glutathione, amino ethyl thiourea, mercapto ethyl alanine and dimethyl sulfoxide was tested. The results showed that in the presence of those substances the radiation effect was diminished. (author).

4338 (INIS-BR–2990) **Monitoring of the radioactive liquid effluents discharged from IPEN-CNEN/SP. Optimization of the procedures adopted.** Seki, C.R. Instituto de Pesquisas Energeticas e Nucleares (IPEN), Sao Paulo, SP (Brazil). 1990 109p. (In Portuguese). Order Number DE93607368. Source: OSTI; NTIS (US Sales Only); INIS.

The main purpose of a radioactive liquid effluents monitoring of a nuclear installation is to determine the amount of radioactivity discharged to the environment, as well as, to verify if this activity is below the authorized discharge limits established by the competent authority. Although this control has been established on a routine basis since the beginning of operation of the nuclear installations available at IPEN, the growing of such facilities in the last years has implied in an increase in the number of samples to be analyzed. The aim of this work is, therefore, to optimize the procedures adopted in the Environmental Monitoring Division of IPEN-CNEN/SP for the activity measurement of the liquid effluents discharged to the environment. Since these effluents are discharged to Pinheiros river, which presents a high dilution factor, a study is also carried out in order to verify if the activity present can be measured by the equipment available. (author).

4339 (INIS-BR–3004) **Cytogenetic studies in workers with chronic occupational radiation exposure.** Grynszpan, D. Universidade do Estado, Rio de Janeiro, RJ (Brazil). Inst. de Biologia. 1989 139p. (In Portuguese). Order Number DE93607232. Source: OSTI; NTIS (US Sales Only); INIS.

The technique of chromosomal aberration detection on peripheral lymphocytes blood samples from monazite industry workers was used to study the cytogenetic effect of low chronic radiation doses. Cells from 51 workers and 21 controls were analysed. Cytogenetic data from individuals from different working areas were statistically compared among themselves and with the control group. The possible correlations between chromosomal aberration frequencies and cumulative external dose and working time were investigated. The influence of smoking was also tested. The link to the wives spontaneous abortions was analysed. Our results indicate possible biological effects on this sample of workers. (author).

4340 (INIS-BR–3006) **Contribution to the study of the red blood cells labelled with chromium-51 and technetium-99 m.** Canine, M.S. Universidade do Estado, Rio de Janeiro, RJ (Brazil). Centro Biomedico. 1983 92p. (In Portuguese). Order Number DE93607233. Source: OSTI; NTIS (US Sales Only); INIS.

Although the bindings of Cr-51 and Tc-99 m were both in the β chain of hemoglobin molecule, the results obtained after previous incubations of the RBC with chromium and technetium, and the determinations of the efficiency of the labeling of RBC showed that the points of fixing of chromium and technetium with β chain of hemoglobin were probably different. The observations through the optic microscope allowed the verification that, at the concentration of 100 mg/ml of Cr-50, there were morphologic in the RBC. These modifications were not found after the other treatments. The comparison between scintigraphy obtained with Tc-99 m or Cr-51 RBC suggested that the technique which employs Tc-99 m can be more adequate than the one with Cr-51. (author).

4341 (INIS-BR–3008) **Brain anomalies induced by gamma irradiation in prenatal period.** Schmidt, S.L. Universidade do Estado, Rio de Janeiro, RJ (Brazil). Centro Biomedico. [1992] 160p. (In Portuguese). Order Number DE93607262. Source: OSTI; NTIS (US Sales Only); INIS.

Gamma irradiation has been utilized in order to produce cortical and callosal abnormalities. We have also checked for the presence of the aberrant longitudinal bundle in the brains of mice born acallosal due to prenatal irradiation is also checked. Pregnant mice were exposed to gamma irradiation from a ^{60} Co source at 16, 17 and 19 days of gestational age (E 16, E 17 and E 19) with total doses of 2 Gy and 3 Gy. At 60 days postnatal the offspring of irradiated animals were intra cardiac perfused, the brains were removed from the cranio and cut into coronal or para sagittal sections. (author).

4342 (INIS-BR–3010) **DNA replication inhibition and recovery in rodents cells irradiated with ultraviolet radiation.** Paixao, J.C. da. Universidade do Estado, Rio de Janeiro, RJ (Brazil). Centro Biomedico. 1986 87p. (In Portuguese). Order Number DE93607200. Source: OSTI; NTIS (US Sales Only); INIS.

The inhibition and the recovery of DNA in rodents cells irradiated with ultraviolet radiation were studied. (L.M.J.).

4343 (INIS-BR–3016) **Determination of behaviour of the corn weevil Sitophilus zeamais, Motschulsky, 1855 (Coleoptera, Curculionidae) in corn, rice and wheat grains by using radioactive tracer Iodine-131.** Pacheco, I.A. Sao Paulo Univ., Piracicaba, SP (Brazil). Escola Superior de Agricultura Luiz de Queiroz. 1989 79p. (In Portuguese). Order Number DE93607263. Source: OSTI; NTIS (US Sales Only); INIS.

The dispersion behaviour and distribution pattern of Sitophilus zeamais Motschulsky, 1855 through a bulk of corn, rice and wheat,leaving from a infestation focus, was investigated by means of tracer methodology. Adults insects were labeled with the gamma emitter ^{131} I, through bath in Na ^{131} I solution and released onto the top of grain mass deposited in cylinders each 430 mm height and 195 mm in diameter, filled to 20 mm of the top with grains. The cylinders were enclosed with lids. The insects were detected through the bulk of the grain by means of a crystal scintillator, in fourteen sites, zero 3, 6, 12, 24, 48, 72, 96 and 120 hours after releasing. (author).

4344 (INIS-BR–3017) **Biological changes in Musca domestica L., 1758 (Diptera:Muscidae), induced by gamma radiation (^{60} Co).** Grecchi, M.A. Sao Paulo Univ., Piracicaba, SP (Brazil). Escola Superior de Agricultura Luiz de Queiroz. 1989 189p. (In Portuguese). Order Number DE93607264. Source: OSTI; NTIS (US Sales Only); INIS.

This work was carried out in the Entomology Section of the Centre of Nuclear Energy in Agriculture (CENA), University of Sao Paulo, Piracicaba, Sao Paulo, Brazil. The objective of the present research work was to investigate some effects of gamma radiation on the various stages of M. domestica life cycle. (author).

4345 (INIS-BR–3021) **Tracing of erythrocytes in vitro with technetium-99 m: clinical applications.** Boasquevisque, E.M. Universidade do Estado, Rio de Janeiro, RJ (Brazil). Centro Biomedico. 1983 135p. (In Portuguese). Order Number DE93607265. Source: OSTI; NTIS (US Sales Only); INIS.

The human beings' erythrocytes were studied in vitro by the pre tinning method, using the pyrophosphate - Stannous Chloride Kit. Investigation of factors that can alter the labeling efficiency includes tin concentration, temperature and incubation period, besides of plasma concentration and hematocrit. It was seen that tin uptake by the red blood cells (RBC) was in an exponential fashion, with a reaction constant, K = 0,03 min $^{-1}$. The reaction approaches the equilibrium about the 90 minutes. The binding of Tc-99 m in the Acidic insoluble fraction occurs in greater amounts with more concentrated tin solutions. The labeled and heated TBC were used in vivo to scintigraphic investigation. Normal subjects, splenomegaly, accessory spleen and splenic function in sickel-cell disease were studied. Circulation time of labeled RBC appears to be greater in sickel-cell anemia than in controls or splenectomized patients. Uptake was greater in kidney than lungs and liver. (author).

4346 (INIS-BR–3025) **Dose distribution and risk factors in tele cobalt therapy and intracavitary treatment with sealed sources of Ceslum-137.** Briquet, C. Universidade do Estado, Rio de Janeiro, RJ (Brazil). Centro Biomedico. 1984 84p. (In Portuguese). Order Number DE93607541. Source: OSTI; NTIS (US Sales Only); INIS.

The purpose of this work is to evaluate dose to organs, outside the treatment volume. The experimental measurements were done using TLD dosemeters, placed in various regions of a Rando Alderson Phantom. The theoretical absorbed doses were calculated using the Monte Carlo method applied to a mathematical phantom. (author).

4347 (INIS-BR–3028) **Development of a postal system for dosimetry quality control performed in photon beams produced by linear accelerators of clinical use.** Di Prinzio, R. Universidade Estadual de Campinas, SP (Brazil). Inst. de Fisica. 1984 121p. (In Portuguese). Order Number DE93607369. Source: OSTI; NTIS (US Sales Only); INIS.

In this work a different system is proposed which is able to verify the absorbed depth dose given at two different depths, the irradiation field homogeneity and its coincidence with the light field of the machine, the source to surface distance used and the beam nominal energy. These radiation field parameters are very important in the tumour treatment and they may help in the determination of the error sources of the absorbed depth dose. The system developed uses a water phantom, LiF thermoluminescent dosemeters and a radiographic film to evaluate such parameters. The postal system developed in this work has been tested in linear accelerators of 4 to 18 MV with good results. (author).

4348 (INIS-BR–3032) **X-rays effect on the proximal tubes of mice kidney (Mus musculus). Ultra-structural study.** Pacheco, I.P. Escola Paulista de Medicina, Sao Paulo, SP (Brazil). 1973 71p. (In Portuguese). Order Number DE93607214. Source: OSTI; NTIS (US Sales Only); INIS.

The kidney alterations in mice it was submitted to total irradiation was studied, trying to determine which lesions were produced and in which sequence its occur. Knowing that irradiation, since in low doses, decrease the organism survival, since anticipating the normal aging, and how it occur and, in event of it occur if such alterations are qualitative and/or quantitatively related with that occur in aging. (L.M.J.).

4349 (INIS-BR–3043) **Study with radio aerosol of DTPA technetium-99 m in individuals with pulmonary disease by amiodarone.** Terra Filho, M. Sao Paulo Univ., SP (Brazil). Faculdade de Medicina. 1989 84p. (In Portuguese). Order Number DE93607234. Source: OSTI; NTIS (US Sales Only); INIS.

In order to evaluate the role of the clearance of 99 m Technetium chelated to diethylenetriamine-penta-acetate (99 m Tc-DTPA) in amiodarone induced pulmonary disease, 40 individuals were studied in four groups. After spirometry, where a volume-time curve was registered, all individuals inhaled 740 MBq of 99 m Tc-DTPA diluted in 4 ml of saline, for five minutes. Pulmonary images were obtained in a computerized scintillation camera and 9 regions of interest were selected. (author).

4350 (INIS-BR–3044) **Pre-operative radiotherapy treatment in uterine cervix voluminous carcinoma clinic phase IB.** Petitto, J.V. Sao Paulo Univ., SP (Brazil). Faculdade de Medicina. 1989 75p. (In Portuguese). Order Number DE93607235. Source: OSTI; NTIS (US Sales Only); INIS.

Forty four patients with voluminous tumor of the uterine cervix were selected and submitted to preoperative radiation with radical dosages in pelvis and to radiation therapy alone. Results as to survival in both of the treatments were similar. Complication rates in both of the treatments were not higher than the acceptable levels. Hospitalization periods were not longer than the usual for Wertheim-Meigs surgery. (author).

4351 (INIS-BR–3047) **Induced sterility through the Ionizing radiation of cobalt 60 in bookworm Plodia interpunctella (Huebner, 1813) (Lepidoptera - pyralidae) in artificial diet.** Barbieri, M.L. Sao Paulo Univ., Ribeirao Preto, SP (Brazil). Faculdade de Filosofia, Ciencias e Letras. 1989 73p. (In Portuguese). Order Number DE93607215. Source: OSTI; NTIS (US Sales Only); INIS.

The steriling doses for different phases of evolutive cycle of Plodia interpunctella (Huebner, 1813) (Lepidoptera - Pyralidae) worm using gamma radiation is studied. (author).

4352 (INIS-BR–3050) **Analysis of the numbers of B, T and subpopulation lymphocytes in patients with breast cancer submitted to a different radiotherapy schedules.** Andrade, J.M. de. Sao Paulo Univ., Ribeirao Preto, SP (Brazil). Faculdade de Medicina. 1989 88p. (In Portuguese). Order Number DE93607218. Source: OSTI; NTIS (US Sales Only); INIS.

The behaviour of T and B lymphocytes subpopulations was evaluated in patients with breast cancer submitted to 3 different schedules of radiotherapy. The assays were carried out before and immediately after the end of treatment. T lymphocytes and the helper/inducer (CD_4) and suppressor/cytotoxic (CD_8) subpopulations were counted by indirect immunofluorescence with monoclonal antibodies of the OKT series. The number of B lymphocytes was obtained by direct immunofluorescence with fluorescein-conjugated anti-human Ig antibodies. The patients were divided into 3 groups: irradiation of the breast only; irradiation of the lymph-draining areas; irradiation of the breast, of the lymph-draining area and of the sternal area. (author).

4353 (INIS-BR–3052) **Study of the behaviour of the yellow cake dissolution in simulated lung fluid.** Souza Mansur, E. de. Universidade do Estado, Rio de Janeiro, RJ (Brazil). Centro Biomedico. 1988 92p. (In Portuguese). Order Number DE93606611. Source: OSTI; NTIS (US Sales Only); INIS.

An in vitro study was performed to determine the solubility of the yellow cake produced in a Brazilian uranium mill to permit classification of the inhaled material and to aid bioassay interpretation. The powder was taken from 6 different lots of yellow cake produced during 10 weeks mill operation period. Dissolution fractions and half-times were obtained using simulated lung fluid in a shaker bath at 37^0 C for 30 days. Uranium concentration were determined by neutron activation analysis. (author).

4354 (INIS-BR–3057) **Contribution to the safety of repairing mechanisms in Staphylococcus epidermidis: characterization of mutants sensible to ultraviolet radiation.** Rocha Guillobel, H.C. da. Universidade Federal, Rio de Janeiro, RJ (Brazil). Inst. de Biofisica. 1985 81p. (In Portuguese). Order Number DE93607207. Source: OSTI; NTIS (US Sales Only); INIS.

Mutants obtained from N - methyl -N' - nitro - N - nitrosoguanidine (MNNG) treatment of the W_5 strain or Staphylococcus epidermidis and selected for their increased UV - sensitivity were characterized according to their capacity to repair DNA damage. The original W_5 parental strain as well as several phenotypically defined strains of Escherichia coli, described in the literature, were used as a reference. The study included: the verification of cellular UVV - and MNNG - sensitivities; the determination of the bacterial potential for phage-reactivation by constitutive enzymatic mechanisms (host cell reactivation), as well as by the action of inducible repair systems (W-reactivation); the assessment of the UV-inductibility of prophage in the lysogenic hosts. (author).

4355 (INIS-GB–451) **Corporate plan 1992/93 to 1996/97.** National Radiological Protection Board, Chilton (United Kingdom). Apr 1992 40p. Order Number DE93607350. Source: OSTI; NTIS (US Sales Only); INIS.

The NRPB Corporate Plan for 1992/93 to 1996/97 is presented. The programme areas include international standards and policy, national standards and policy, dosimetry of radionuclides, physical dosimetry, evaluation of radiation risks, environmental studies, assessment of controlled releases, accident assessment and emergency planning, exposure of the population, occupational exposure to ionising radiations, non-ionising radiations, technical services to radiation users, radiation protection advisory service, training and central technical services. (UK).

4356 (INIS-mf–13375, pp. 5) **Assessment of gamma and X-ray doses by LIF-7 thermoluminescence dosemeters.** El-Bakkoush, F.A. (Radiation Shielding Laboratory, Tajoura Nuclear Research Centre, Secretariat of Atomic Energy, Tripoli (Libya)); Akki, T.S.; Megahid, R.M. Tajoura Nuclear Research Centre, Tripoli (Libyan Arab Jamahiriya). 1984. 82p. (CONF-8409421–: Seminar on the use of research reactors in fundamental and applied sciences, Tajoura (Libyan Arab Jamahiriya), 16 Sep 1984). In *Seminar on the use of research reactors in fundamental and applied sciences. Programme and abstracts.* Order Number DE93606515. Source: Also available from Tajoura Nuclear Research Centre, Tajoura/Tripoli, Libya.

Short communication. THERMOLUMINESCENT DOSIMETRY; GAMMA RADIATION; RADIATION DOSES; SHIELDING MATERIALS; X RADIATION

4357 (INIS-mf–13376, pp. 58-60) **Short information about results of studies subsequent to realization of MZ-17 program "Late consequences of some preventive actions undertaken in consequence of country contamination after nuclear power plant accident at Chernobyl" in 1986-89.** Nauman, J. National Atomic Energy Agency, Warsaw (Poland). Apr 1990. 60p. (In Polish). In *Four years after nuclear power plant accident at Chernobyl.* Order Number DE93607099. Source: OSTI; NTIS (US Sales Only); INIS.

Preliminary results of the studies on absorbed dose of iodine 131, influence of contamination on thyroid diseases, late unfavourable effects of potassium iodide, influence of iodine 131 on fetuses' thyroid as well as influence of contamination and potassium iodide on recurrence of thyroid diseases are presented. (A.S.).

4358 (INIS-mf–14085, pp. 87-98) **Natural and anthropogeneous radiation in the Erzgebirge: Risk factor radon.** Jacobi, W. (GSF - Forschungszentrum fuer Umwelt und Gesundheit GmbH, Neuherberg (Germany)). GSF - Forschungszentrum fuer Umwelt und Gesundheit GmbH, Neuherberg (Germany). May 1992. 144p. (In German). (CONF-9112144–: Press seminar of the GSF Project 'Information Environment', Berlin (Germany), 3-4 Dec 1991). In *Current environmental situation in the new Federal States. Pt. 1.* Order Number DE93728679. Source: OSTI; NTIS (US Sales Only); INIS.

The geological formations in the saxoinian-thuringian low mountain range contain rocks with a relatively high share of uranium (^{238}U) and its follow-up product radium (^{226}Ra). Independent of mining this results in increased radiation levels to which the local population has always been exposed. Natural radiation levels may, of course, vary strongly from one location to the next and therefore human exposure varies accordingly. (orig.).

4359 (IPEN-DT–2) **Black beams (Phaseolus vulgaris) diets' effects heating in different ways and times with or without methionine addition, in growth, liver and mice thyroid, using oleic acid ^{125} I.** Pereira, N.P.S. de. Instituto de Pesquisas Energeticas e Nucleares (IPEN), Sao Paulo, SP (Brazil). Dec 1979. 66p. (In Portuguese). Order Number DE93607266. Source: OSTI; NTIS (US Sales Only); INIS.

Weanling rats were divided into 13 groups of six animals and were fed 'ad libitum' for four weeks with diets containing casein as protein source for the control group and bean cooked in an autoclave at 120^0 C for 30, 45 and 60 minutes or cooked in an ordinary pot for 60, 120 and 180 minutes, with and without addition of methionine. Oleic acid ^{125} I, mixed with other nutrients, was added to the diets in order to study the distribution of radioactivity in the animal body and its excretion. The influence of heating the beans by different ways and times, with and without addition of methionine, on the growth of the animals was verified by means of the gain in weight, food efficiency ratio (FER) and protein efficiency ratio (PER). Studies in animal feces, urine and carcass were carried out. The quantity of lipids in the feces and carcass was determined. The influence of the diets on the liver and thyroid was verified by means of their weights and the quantity of radioactivity in these organs. (author).

4360 (Juel–2610) **Measuring program of the Federal Republic of Germany. Results of the whole-body counting in Russia during the period of June 17 to October 4, 1991.** Hille, P.; Hille, R. Forschungszentrum Juelich GmbH (Germany). Abt. Sicherheit und Strahlenschutz. Apr 1992. 135p. (In German). Order Number DE93728908. Source: OSTI; NTIS (US Sales Only); INIS.

The body content of radionuclides of close to 160.000 persons in the RSFSR has been examined during summer 1991. An area of approximately 10000 km^2 extending from close-to-Moskow Tula up to Slynka at the Byelorussian border and such including regions of low and high contamination levels in the districts of Briansk, Kaluga, Arel and Tula has been covered in the survey. Up to 7 mobile whole-body counting laboratories have been operational with a total number of 20 counters. More than 100 german specialists have participated in the task group. Each person examined received an official certificate given the activity of the Cs 137/134 mixture in the body and a judgement on the radiation risk involved. Observed activity levels were generally much less and in no case higher than the annual limit of intake acceptable for professional radiation workers. Only for less than 1% of the people examined the results suggest the necessity of a further surveillance by health physicists and physicians similar to the regular medical examination professional radiation workers undergo. (orig.).

4361 (NUREG/CR–5512-Vol.1) **Residual radioactive contamination from decommissioning: Technical basis for translating contamination levels to annual total effective dose equivalent: Final report: Volume 1.** Kennedy, W.E. Jr. (Pacific Northwest Lab., Richland, WA (United States)); Strenge, D.L. Nuclear Regulatory Commission, Washington, DC (United States).

Div. of Regulatory Applications; Pacific Northwest Lab., Richland, WA (United States). Oct 1992. 356p. Sponsored by Nuclear Regulatory Commission, Washington, DC (United States). DOE Contract AC06-76RL01830. (PNL–7994-Vol.1). Source: OSTI; NTIS; INIS; GPO.

This document is the first volume of a three-volume report to provide generic and site-specific estimates of radiation dose for exposures to residual radioactive contamination after the decommissioning of facilities licensed by the US Nuclear Regulatory Commission (NRC). Details are provided of the generic scenario and pathway modeling analysis. Included are descriptions of the scenarios, models, mathematical formulations, assumptions, and justifications of parameter selections. Volume 1 was produced after consideration of public comments received on the January 1990 review draft. The generic modeling addresses residual radioactive contamination inside buildings and in soils. For buildings, two scenarios are presented to relate volume and surface contamination levels to estimates of the annual total effective dose equivalent (TEDE) or the TEDE (as defined in 10 CFR 20) received during a year of exposure with the conditions defined in the scenarios. Because of concerns regarding potential ground-water contamination from residual radioactive contamination in soil, a generic to permit evaluation of the annual TEDE for drinking water from wells. The generic water-use model was also used in the evaluation of multiple pathways associated with contaminated soil. The generic treatment of potentially complex ground-water systems used here provides a conservative analysis that may only indicate that additional site data and more sophisticated modeling are warranted. The scenarios, models, mathematical formulations, and selected parameter values are intended to serve as the technical basis for the NRCs derivation of screening values supporting its development of policy applied to residual radioactive contamination from decommissioning.

4362 (ORNL/TM–12255) **Marrow cell kinetics model: Equivalent prompt dose approximations for two special cases.** Morris, M.D.; Jones, T.D. Oak Ridge National Lab., TN (United States). Nov 1992. 20p. Sponsored by Department of Defense, Washington, DC (United States). DOE Contract AC05-84OR21400. Order Number DE93003264. Source: OSTI; NTIS; GPO Dep.

Two simple algebraic expressions are described for approximating the "equivalent prompt dose" as defined in the model of Jones et al. (1991). These approximations apply to two specific radiation exposure patterns: (1) a pulsed dose immediately followed by a protracted exposure at relatively low, constant dose rate and (2) an exponentially decreasing exposure field.

4363 (PNL–8360) **Scoping assessment of radiological doses to aquatic organisms and wildlife – N Springs.** Poston, T.M.; Soldat, J.K. Pacific Northwest Lab., Richland, WA (United States). Oct 1992. 16p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE93003286. Source: OSTI; NTIS; INIS; GPO Dep.

Estimated does rates were determined for endemic biota inhabiting the N Springs area based primarily on spring water data collected from the first 6 months of 1991. Radiological dose estimates were computed from measured values of specific radionuclides and modeled levels of radionuclides using established computer codes. The highest doses were predicted in hypothetical populations of clams, fish-eating ducks, and rabbits. The calculated dose estimates did not exceed 1 rad/d, an administrative dose rate established by the US Department of Energy for the protection of native aquatic biota. An administrative dose rate has not been established for terrestrial wildlife.

4364 (PNWD–2020-HEDR) **Integrated Task Plans for the Hanford Environmental Dose Reconstruction Project, FY 1992 through May 1994.** Shipler, D.B. Pacific Northwest Lab., Richland, WA (United States). Sep 1992. 242p. Sponsored by USDOE, Washington, DC (United States); Department of Health and Human Services, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE93001345. Source: OSTI; NTIS; INIS; GPO Dep.

The purpose of the Hanford Environmental Dose Reconstruction (HEDR) Project is to estimate radiation doses from Hanford Site operations since 1944 to populations and individuals. The primary objective of work to be performed through May 1994 is to (1) determine the project's appropriate scope (space, time, radionuclides, pathways and individuals/population groups), (2) determine the project's appropriate level of accuracy (level of uncertainty in dose estimates) for the project, (3) complete model and data development, and (4) estimate doses for the Hanford Thyroid Disease Study (HTDS), representative individuals, and special populations as described herein. The plan for FY 1992 through May 1994 has been prepared based on activities and budgets approved by the Technical Steering Panel (TSP) at its meetings on August 19–20, 1991, and April 23–25, 1992. The activities can be divided into four broad categories: (1) model and data evaluation activities, (2)additional dose estimates, (3) model and data development activities, and (4)technical and communication support.

4365 (PNWD–2021-HEDR) **Project Management Plan for the Hanford Environmental Dose Reconstruction Project.** Shipler, D.B.; McMakin, A.H.; Finch, S.M. Battelle Pacific Northwest Lab., Richland, WA (United States). Sep 1992. 62p. Sponsored by Department of Health and Human Services, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE93001494. Source: OSTI; NTIS; GPO Dep.

This Project Management Plan (PMP) describes the approach being used to manage the Hanford Environmental Dose Reconstruction (HEDR) Project. The plan describes the management structure and the technical and administrative control systems used to plan and control HEDR Project performance. The plan also describes the relationship among key project participants: Battelle, the Centers for Disease control (CDC), and the Technical Steering Panel (TSP). Battelle's contract with CDC only extends through May 1994 when the key technical work will be completed. Therefore, this plan is focused only on the period during which Battelle is a participant.

4366 (PNWD–2022-HEDR) **Commercial production and distribution of fresh fruits and vegetables: A scoping study on the importance of produce pathways to dose: Hanford Environmental Dose Reconstruction Project.** Marsh, T.L.; Anderson, D.M.; Farris, W.T.; Ikenberry, T.A.; Napier, B.A.; Wilfert, G.L. Pacific Northwest Lab., Richland, WA (United States). Sep 1992. 87p. Sponsored by Department of Health and Human Services, Washington, DC (United States). DOE Contract AC06-76RL01830. Contract 200-92-0503(CDC)/18620(BNW). Order Number DE93001493. Source: OSTI; NTIS; GPO Dep.

This letter report summarizes a scoping study that examined the potential importance of fresh fruit and vegetable pathways to dose. A simple production index was constructed with data collected from the Washington State Department of Agriculture (WSDA), the United States Bureau of the Census, and the United States Department of Agriculture (USDA). Hanford Environmental Dose Reconstruction (HEDR) Project staff from Battelle, Pacific Northwest Laboratories, in cooperation with members of the Technical Steering Panel (TSP), selected lettuce and spinach as the produce pathways most likely to impact dose. County agricultural reports published in 1956 provided historical descriptions of the predominant distribution patterns of fresh lettuce and spinach from production regions to local population centers. Pathway rankings and screening dose estimates were calculated for specific populations living in selected locations within the HEDR study area.

4367 (PNWD–2023-HEDR) **Parameters used in the environmental pathways (DESCARTES) and radiological dose (CIDER) modules of the Hanford Environmental Dose Reconstruction Integrated Codes (HEDRIC) for the air pathway: Hanford Environmental Dose Reconstruction Project.** Snyder, S.F.; Farris, W.T.; Napier, B.A.; Ikenberry, T.A.; Gilbert, R.O. Pacific Northwest Lab., Richland, WA (United States). Sep 1992. 155p. Sponsored by USDOE, Washington, DC (United States); Department of Health and Human Services, Washington, DC (United States). DOE Contract AC06-76RL01830. Contract 200-92-0503(CDC)/18620(BNW). Order Number DE93000840. Source: OSTI; NTIS; INIS; GPO Dep.

This letter report is a description of work performed for the Hanford Environmental Dose Reconstruction (HEDR) Project. The HEDR Project was established to estimate the radiation doses to

individuals resulting from releases of radionuclides from the Hanford Site since 1944. This work is being done by staff at Battelle, Pacific Northwest Laboratories (Battelle) under a contract with the Centers for Disease Control (CDC) with technical direction provided by an independent Technical Steering Panel (TSP). The objective of this report is to-document the environmental accumulation and dose-assessment parameters that will be used to estimate the impacts of past Hanford Site airborne releases. During 1993, dose estimates made by staff at Battelle will be used by the Fred Hutchinson Cancer Research Center as part of the Hanford Thyroid Disease Study (HTDS). This document contains information on parameters that are specific to the airborne release of the radionuclide iodine-131. Future versions of this document will include parameter information pertinent to other pathways and radionuclides.

4368 (PNWD–2024-HEDR) **Declassifications requested by the Technical Steering Panel of Hanford documents produced 1944–1960: Hanford Environmental Dose Reconstruction Project.** Gydesen, S.P. Pacific Northwest Lab., Richland, WA (United States). Sep 1992. 217p. Sponsored by USDOE, Washington, DC (United States); Department of Health and Human Services, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE93001492. Source: OSTI; NTIS; INIS; GPO Dep.

The purpose of this letter report is to list the actions taken on historical documents that the Technical Steering Panel (TSP) and/or the public identified as being of potential use to the Hanford Environmental Dose Reconstruction (HEDR) Project. The documents addressed herein were generated from 1944 through 1960 at the Hanford Site and were still listed as classified documents in 1990. This report lists the 1429 documents and their classification status. All TSP- and/or public-requested declassifications of Hanford historical documents generated from 1944–1960 have been completed. Of the 1429 documents, 1103 were declassified. (492 as a result of TSP/public requests, 506 previously declassified, 105 declassified for other programs). The remaining 326 documents were not declassified because either they were determined by the TSP to be not applicable to the HEDR Project or because of the reasons given in the appendixes. Of the 1103 declassified documents, 506 have not been reviewed by the TSP for their pertinence to the HEDR Project. Figure I provides an overview of the declassification process.

4369 (PNWD–2033-HEDR-Vol.1) **Iodine-131 releases from the Hanford Site, 1944–1947: Volume 1, Text: Hanford Environmental Dose Reconstruction Project.** Heeb, C.M. Battelle Pacific Northwest Lab., Richland, WA (United States). Oct 1992. 111p. Sponsored by Department of Health and Human Services, Washington, DC (United States). DOE Contract AC06-76RL01830. Contract 200-92-0503 (CDC)/18620 (BNW). Order Number DE93002040. Source: OSTI; NTIS; GPO Dep.

Releases of fission product iodine-131 from separation plants at the Hanford reservation are calculated for the 1944 through 1947 period. Releases to the atmosphere were from the ventilation stacks of T and B separation plants. A reconstruction of daily separation plant operations forms the basis of the releases. The reconstruction traces the iodine-131 content of each fuel discharge from the B, D, and F Reactors to the dissolving step in the separation plants. Statistical computer modeling techniques are used to estimate hourly release histories based on sampling mathematical distribution functions that express the uncertainties in the source data and timing. The reported daily, monthly, and yearly estimates are averages and uncertainty ranges are based on 100 independent Monte Carlo "realizations" of the hourly release histories.

4370 (PNWD–2033-HEDR-Vol.2) **Iodine-131 releases from the Hanford Site, 1944–1947: Volume 2, Data: Hanford Environmental Dose Reconstruction Project.** Heeb, C.M. Battelle Pacific Northwest Lab., Richland, WA (United States). Oct 1992. 229p. Sponsored by Department of Health and Human Services, Washington, DC (United States). DOE Contract AC06-76RL01830. Contract 200-92-0503 (CDC)/18620 (BNW). Order Number DE93002041. Source: OSTI; NTIS; INIS; GPO Dep.

Detailed results of the Hanford Environmental Dose Reconstruction (HEDR) iodine-131 release reconstruction are presented in this volume. Included are daily data on B, D, and F Plant, reactor operations from the P-Department Daily Reports (General Electric Company 1947). Tables of B and T Plant material processed from the three principal sources on separations plant operations: The Jaech report (Jaech undated), the 200 Area Report (Acken and Bird 1945; Bird and Donihee 1945), and the Metal History Reports (General Electric Company 1946). A transcription of the Jaech report is also provided because it is computer-generated and is not readily readable in its original format. The iodine-131 release data are from the STRM model. Cut-by-cut release estimates are provided, along with daily, monthly, and yearly summations. These summations are based on the hourly release estimates. The hourly data are contained in a 28 megabyte electronic file. Interested individuals may request a copy.

4371 (STUK-A–100) **Biological effects of radiation: The induction of malignant transformation and programmed cell death.** Servomaa, K. Finnish Centre for Radiation and Nuclear Safety (STUK), Helsinki (Finland). Apr 1991. 132p. Order Number DE93607201. Source: OSTI; NTIS; INIS.

The thesis includes also seven previously published articles.

In the Chernobyl explosions and fire, powderized nuclear fuel was released from the reactor core, causing an unexpected fallout. X-ray analysis and scanning electron microscopy showed that the isolated single particles were essentially pure uranium. These uranium aerosols contained all of the nonvolatile fission products, including the b-emitters, ^{95}Zr, ^{103}Ru, ^{106}Ru, ^{141}Ce, and ^{144}Ce. The hot particles are extremely effective in inducing malignant transformation in mouse fibroblast cells in vitro. The major factor responsible for this effect is focus promotion caused by a wound-mediated permanent increase in cell proliferation (mitogenesis associated with mutagenesis). Transformed foci were analysed for the activation of c-abl, c-erb-A, c-erb-B, c-fms, c-fos, c-myb, c-myc, c-Ha-ras, c-Ki-ras, c-sis, and c-raf oncogenes at the transcriptional level. The pattern of oncogene activation was found to vary from focus to focus. Long interspersed repeated DNA (L1 or LINE) makes up a class of mobile genetic elements which can amplify in the cell genome by retroposition. This element is spontaneously transcriptionally activated at a critical population density and later amplified in rat chloroleukaemia cells. UV light and ionizing radiation induce this activation prematurely, and the activation is followed by programmed cell death (apoptosis) in a sequence of events identical to that seen in LIRn activation occurring spontaneously.

4372 (WSRC-MS–92-349) **Deer monitoring at the Savannah River Site.** Fledderman, P.D. Westinghouse Savannah River Co., Aiken, SC (United States). [1992]. 20p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC09-89SR18035. (CONF-930130–1: 26. Health Physics Society midyear topical meeting on environmental health physics, Coeur d'Alene, ID (United States), 24-28 Jan 1993). Order Number DE93000705. Source: OSTI; NTIS; INIS; GPO Dep.

To protect public health, all deer and feral hogs harvested at the Savannah River Site (SRS) during controlled hunts are monitored for Cs-137. A new monitoring program has been developed by the Environmental Monitoring Section (EMS). To provide increased confidence in dose data and compliance with regulations, many changes have been made to the deer and hog monitoring program. Using field count information, a computerized database determines Cs-137 concentration and calculates the committed effective dose equivalent (CEDE) resulting from consumption of the animal. The database then updates each hunter's cumulative CEDE in real time. Also, enhancements to the instrument calibration and quality control portions of the monitoring program were implemented. These include improved monitor calibration, intercomparison of field results from the same animal using different detectors, and regular use of check sources to verify equipment performance. With these program changes, EMS can produce more accurate and verifiable dose data.

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Refer also to citation(s) 2521, 2615, 2817, 2880, 3796, 4111, 4134, 4152, 4225, 4227, 4240, 4301

4373 (CONF-910550–, pp. 273-281) **Influence of ammonium chloride on growth and fatty acid production by Spirulina platensis.** Manabe, E. (Advanced Technology Research Lab., Osaku (Japan)); Hirano, M.; Takano, H.; Ishikawadoi, N.; Sode, K.; Matsunaga, T. National Renewable Energy Lab., Golden, CO (United States); Oak Ridge National Lab., TN (United States). 1992. From 13. symposium on biotechnology for fuels and chemicals; Colorado Springs, CO (United States); 6-10 May 1991. In *Thirteenth symposium on biotechnology for fuels and chemicals: Proceedings.* 846p. Source: The Humana Press, Inc., Totowa, NJ 07511 (United States).

Changes in growth and fatty acid content of Spirulina platensis were examined after transferring cells into media containing various concentrations of ammonium chloride. Photosynthetic 0_2 evolution rate decreased with increasing ammonium chloride concentration. Therefore, the algal growth was interrupted by ammonium chloride addition. On the other hand, total fatty acid content markedly increased after addition of ammonium chloride to a concentration of 15-50 mM and was maximized 40-48 h after addition of 25 mM ammonium chloride. The increases in palmitic and oleic acid content were especially remarkable. However, this began to decrease 48 h after the addition of 25 mM of ammonium chloride. Also, y-linolenic acid content increased continuously during a 72-h incubation. As a result, Spirulina platensis cells containing about 2% y-linolenic acid were obtained by ammonium chloride treatment, representing an increase of 1.5-2-fold compared to untreated cells.

4374 (CONF-910550–, pp. 233-246) **Influence of hydrogen sulfide on the growth and metabolism of Butyribacterium methylotrophicum and Clostridium acetobutylicum.** Grethlein, A.J. (Michigan Biotechnology Inst., Lansing (United States)); Worden, R.M.; Soni, B.K.; Jain, M.K. National Renewable Energy Lab., Golden, CO (United States); Oak Ridge National Lab., TN (United States). 1992. DOE Contract FG21-90MC27400 ;AC22-90PC90051. From 13. symposium on biotechnology for fuels and chemicals; Colorado Springs, CO (United States); 6-10 May 1991. In *Thirteenth symposium on biotechnology for fuels and chemicals: Proceedings.* 846p. Source: The Humana Press, Inc., Totowa, NJ 07511 (United States).

Studies were conducted to determine the effect of hydrogen sulfide (H_2S) on the growth and metabolism of Butyribacterium methylotrophicum and Clostridium acetobutylicum during batch culture. Hydrogen sulfide concentrations in the range of those present in typical synthesis gas mixtures were examined. Growth rates and product compositions were unaffected by total liquid-phase sulfide concentrations ranging from 0.0 to 2.0 mmol/L for B. methylotrophicum and 0.0 to 0.9 mmol/L for C. acetobutylicum. An analysis of the effect of H_2S equilibrium partitioning, media pH, and gas-liquid equilibration rates on this system is presented.

4375 (CONF-910550–, pp. 377-382) **Bioleaching of low-grade copper ores using Thiobacillus ferrooxidans.** Hazra, T.K. (Univ. of College of Science, Calcutta (India)); Mukherjea, M.; Mukherjea, R.N. National Renewable Energy Lab., Golden, CO (United States); Oak Ridge National Lab., TN (United States). 1992. From 13. symposium on biotechnology for fuels and chemicals; Colorado Springs, CO (United States); 6-10 May 1991. In *Thirteenth symposium on biotechnology for fuels and chemicals: Proceedings.* 846p. Source: The Humana Press, Inc., Totowa, NJ 07511 (United States).

Microbial leaching of copper ores using T. ferrooxidans is becoming increasingly important, and it is estimated to account for more than 10% of copper output throughout the world. However, although extensive studies are reported on bioleaching of metal sulfides using T. ferrooxidans, there is still limited understanding about the exact mechanism of the electron transfer process involved. T. ferrooxidans, a gram-negative chemolithotropic bacterium, uses Fe^{2+} as the sole source of energy and assimilates CO_2 at the expense of energy derived from oxidative phosphorylation. Electron transport chain components involved in the oxidation of Fe^{2+} reportedly include rusticyanin and several cytochromes of a and c types. Rusticyanin is a soluble type 1 blue copper protein present in the periplasmic space of the bacterium, consisting of a single polypeptide chain with one copper atom as a cofactor. It has a mol wt of 16,300 Da and has an absorption maxima at 597. Diethyl dithiocarbamate [DEDC] reportedly shows antimicrobial activity against some organisms, such as E. coli, Klebsiella pneumoniae, Proteus vulgaris, Salmonella, Serratia, Candida and so on. Since its action on T. ferrooxidans has not been observed so far, DEDC has been used in the present study as a tool for understanding the electron transfer mechanism involving rusticyanin in the bioleaching process.

4376 (CONF-910550–, pp. 449-458) **CO_2 removal by high-density culture of a marine cyanobacterium Synechococcus sp. using an improved photobioreactor employing light-diffusing optical fibers.** Takeyama, H. (Tokyo Univ. of Agriculture and Technology, Tokyo (Japan)); Nakamura, N.; Sode, K.; Burgess, J.G.; Matsunaga, T.; Takano, H.; Manabe, E.; Hirano, M. National Renewable Energy Lab., Golden, CO (United States); Oak Ridge National Lab., TN (United States). 1992. From 13. symposium on biotechnology for fuels and chemicals; Colorado Springs, CO (United States); 6-10 May 1991. In *Thirteenth symposium on biotechnology for fuels and chemicals: Proceedings.* 846p. Source: The Humana Press, Inc., Totowa, NJ 07511 (United States).

A light diffusing optical fiber (LDOF) photobioreactor with an improved gas input system has been used for the high-density culture of a marine cyanobacterium Synechococcus sp. optimum conditions for CO_2 removal and biomass production were investigated. Maximum CO_2 removal of 4.44 g/L/d was achieved using an initial cell concentration of 6.8 g/L. The biomass yield was 0.97 g/L for a 12-culture time. Continuous cultures, in which medium was filtered using a ceramic membrane module, showed enhanced growth, with a final cell concentration of 11.2 g/L. These results demonstrate the potential of LDOF photobioreactor units for CO_2 removal and biomass production using marine cyanobacteria.

4377 (CONF-910550–, pp. 671-680) **Henry's law constant for environmentally significant compounds.** Moore, R.C. (Univ. of Tennessee, Knoxville (United States)); Bienkowski, P.R. National Renewable Energy Lab., Golden, CO (United States); Oak Ridge National Lab., TN (United States). 1992. From 13. symposium on biotechnology for fuels and chemicals; Colorado Springs, CO (United States); 6-10 May 1991. In *Thirteenth symposium on biotechnology for fuels and chemicals: Proceedings.* 846p. Source: The Humana Press, Inc., Totowa, NJ 07511 (United States).

Many nonvolatile organic compounds, e.g., polyaromatic hydrocarbons (PAHs), are readily stripped during aerobic biodegradation. This is because of the high infinite dilution activity coefficient resulting from forces generated by the water-organic interactions at the molecular level. Several models have been proposed for air-stripping based on the Henry's law constant. By definition, the Henry's law constant is the infinite dilution activity coefficient multiplied by the pure component vapor pressure. In this article, a gas saturation technique was used to measure the very low vapor pressures exhibited by these nonvolatile compounds. Literature values of other PAHs have been tabulated and are presented. For determining infinite dilution activity coefficients, a differential ebulliometery apparatus has been constructed. In this technique, the boiling point difference between pure water and a water-organic solution is measured very precisely. Thermodynamics is then used to calculate the infinite dilution activity coefficient. The method's accuracy has been tested using the phenol- water system.

4378 (CONF-910550–, pp. 693-707) **Tributyl phosphate degradation by immobilized cell of a Citrobacter sp.** Owen, S. (Univ. of Oxford (United Kingdom)); Jeong, B.C.; Poole, P.S.; Macaskie, L.E. National Renewable Energy Lab., Golden, CO (United States); Oak Ridge National Lab., TN (United States). 1992. From 13. symposium on biotechnology for fuels and chemicals; Colorado Springs, CO (United States); 6-10 May 1991. In *Thirteenth symposium on biotechnology for fuels and chemicals: Proceedings.* 846p. Source: The Humana Press, Inc., Totowa, NJ 07511 (United States).

Tributyl phosphate (TBP), a plasticizer and solvent, is used in nuclear fuel reprocessing, generating TBP wastes laden with residual uranium. A Citrobacter sp. accumulated heavy metals via a phosphohydrolase(s) that precipitated metals with inorganic phosphate liberated from an organic phosphate 'donor' molecule (TBP). Mutant analysis suggested that TBP hydrolysis was not attributable

to a previously documented acid phosphatase (monoesterase). Purified monoesterase had little activity against phospho di- and triesters, had no requirement for Mg^{2+} or Mn^{2+}, and was EDTA-resistant. Conversely, TBP cleavage by immobilized cells was enhanced by Mg^{2+}, and in-inhibited by Mn^{2+} and EDTA. A separate phosphotri/diesterase was implicated.

4379 (CONF-910550–, pp. 811-817) **Microbial stabilization of active-sulfide sludges.** Sublette, K.L. (Univ. of Tulsa, OK (United States)). National Renewable Energy Lab., Golden, CO (United States); Oak Ridge National Lab., TN (United States). 1992. From 13. symposium on biotechnology for fuels and chemicals; Colorado Springs, CO (United States); 6-10 May 1991. In *Thirteenth symposium on biotechnology for fuels and chemicals: Proceedings.* 846p. Source: The Humana Press, Inc., Totowa, NJ 07511 (United States).

In the petroleum industry, crude oil is often stored with water in water displacement tanks. In these tanks, both aerobic oil-oxidizing bacteria (OOB) and anaerobic sulfate-reducing bacteria (SRB) exist in the oil/water system (1,2). The SRB utilize sulfate as a terminal electron acceptor with reduction to sulfide. The OOB create anaerobic conditions in these oil/water systems by removal of oxygen and produce organic acids that may act as substrates for the SRB. Therefore, the SRB begin to produce sulfide under anaerobic conditions. Sulfides produced by the SRB result in corrosion in steel tanks producing a variety of iron-sulfur compounds. Those compounds with iron:sulfide ratios of 1:2 (pyrite and marcasite) are pH and temperature stable. However, compounds with iron:sulfide ratios of 1:1 (mackinawite and pyrrhotite) and 3:4 (greigite and smythite) are soluble in mild acid with formation of H_2S. This article describes a preliminary investigation of the anaerobic oxidation of active-sulfide sludges by the chemoautotroph and facultative anaerobe Thiobacillus denitrificans. T. denitrificans utilizes reduced sulfur compounds as energy sources with oxidation to sulfate. Under anaerobic conditions, nitrate may be used as a terminal electron acceptor with reduction to elemental nitrogen. Sublette and Sylvester have demonstrated that T. denitrificans may be readily cultured aerobically and anaerobically in batch and continuous reactors on gaseous H_2S under sulfide-limiting conditions. A microbial process for the removal of H_2S from a gas has been proposed based on contact of the gas with a culture of T. denitrificans. Immobilized T. denitrificans has also been used to remove and oxidize sulfides in sour water containing H_2S, HS and/or S^{-2} in an upflow bubble column. These reactors have successfully operated continuously for up to 9 mo.

4380 (CONF-910550–, pp. 819-826) **Chemical interaction of flue gas components with the growth of Cyanidium caldarium.** Woodward, C.A. (Oak Ridge National Lab., TN (United States)); MacInnis, J.M.; Lewis, S.N.; Greenbaum, E. National Renewable Energy Lab., Golden, CO (United States); Oak Ridge National Lab., TN (United States). 1992. From 13. symposium on biotechnology for fuels and chemicals; Colorado Springs, CO (United States); 6-10 May 1991. In *Thirteenth symposium on biotechnology for fuels and chemicals: Proceedings.* 846p. Source: The Humana Press, Inc., Totowa, NJ 07511 (United States).

Flue gas released into the atmosphere from fossil fuel combustion contains carbon dioxide, a major contributor to possible global warming and the greenhouse effect. Photosynthetic processes result in the reduction of CO_2 to carbohydrate and the evolution of molecular oxygen from water. A photosynthetic organism growing in a process off-gas stream could effectively recycle CO_2 to nonpolluting products, especially if it could survive the high acid, sulfur dioxide, and low O_2 concentrations that are also present in flue gas. Cyanidium caldarium, a microalga isolated from acid sulfur hot springs in Yellowstone National Park, has been shown to be tolerant of such extreme conditions (1). It is thermophilic and acidophilic, and grows in 1M sulfuric acid at 70C, as well as anaerobically in high concentrations Of CO_2 (2). It is therefore a suitable candidate for the study of stress-tolerant algal CO_2 reduction in stack gas atmospheres. The purpose of the present work was to determine the conditions under which Cyanidium would grow and to measure the rate of its photosynthetic production of oxygen in a flue gas atmosphere.

4381 (CONF-9109358–, pp. 11) **Receptor-bound toxicants as biomarkers for environmental pollutants.** Saleh, M.A. (Texas Southern University, Houston (United States)); El-Baroty, G.; Affify, A.M.; Reheim, E.A. USDOE, Washington, DC (United States). [1991]. From 8. international conference on chemistry for protection of the environment; Lublin (Poland); 16-18 Sep 1991. In *Chemistry for protection of the environment, Eight international conference: Proceedings.* 635p. Order Number DE92014317. Source: OSTI; NTIS; INIS.

Lindane, toxaphene, endosulfan, endrin, ketoendrin, aldein, dieldrin, heptachlor, pyrethroids insecticides and some of their metabolites are central nervous system toxicants and they have shown to exert their effect by binding to specific sites in the gamma-aminobutyric acid (GABA) receptor-ionophore complex. Radioreceptor assay was also examined as a potential biomarker for monitoring human exposure to this group of insecticides. GABA receptor was prepared form P_2 (mitochondrial) fraction of rats and calf brain homogenate. The assay is conducted by measuring the displacement of radioactivity following incubation of the receptor with environmental samples, human bloods or other fluid. The assay was shown to be very sensitive and required very little or no sample preparation or clean up prior to the analysis.

4382 (CONF-9109358–, pp. 8) **Computer-assisted molecular modeling and prediction of the physical, chemical and biological fate of environmental pollutants.** Saleh, M.A. (Texas Southern University, Houston (United States)). USDOE, Washington, DC (United States). [1991]. From 8. international conference on chemistry for protection of the environment; Lublin (Poland); 16-18 Sep 1991. In *Chemistry for protection of the environment, Eight international conference: Proceedings.* 635p. Order Number DE92014317. Source: OSTI; NTIS; INIS.

Knowledge about the physical, chemical and biological degradation of environmental pollutants is the key to evaluating their toxicological effects and environmental fate. Laboratory identification of metabolites and studies of environmental degradation are very costly and time-consuming. Several artificial intelligence software packages capable of predicting metabolism, hazardous effect and environmental fate of environmental pollutants have recently became available. In this paper, the results of using computer-assisted modeling for the prediction of metabolism, environmental fate and hazardous effects are discussed and compared to those actually obtained form data derived by laboratory techniques for selected groups of environmental pollutants and agrochemicals.

4383 (CONF-9109358–, pp. 6) **Determining inhibition potential of wastewaters by means of a computerized respirometer and a standardized microbial culture.** Beach, M.I. (N-CON Systems Co., Larchmont, NY (United States)); Cadena, F.; Troop, L.M. USDOE, Washington, DC (United States). [1991]. From 8. international conference on chemistry for protection of the environment; Lublin (Poland); 16-18 Sep 1991. In *Chemistry for protection of the environment, Eight international conference: Proceedings.* 635p. Order Number DE92014317. Source: OSTI; NTIS; INIS.

Although many chemicals and chemical compounds can be treated by biological processes, great care must be taken to assure that discharges do not exceed the capability of the biomass in the treatment facility. Monitoring the oxygen uptake rate (OUR) of trade wastes and prompt determination of their inhibition potential can prevent costly upsets. In order to be effective, a monitoring technique should be rapid, accurate, reliable, and require minimum operator time and skill. The method described is based on several established comparative tests, but simplified by using oxygen uptake rate (OUR) data generated and interpreted by a computerized respirometer using a commercially available, standardized, broad spectrum microbial culture. The availability of a standard bacteria culture enhances the repeatability of OUR tests is essential for correlating the effects of wastes in various parts of the world.

4384 (DOE/ER/60655–T1) **Regional aerosol deposition in human upper airways: Progress report, March 1, 1992–February 28, 1993.** Swift, D.L. Johns Hopkins Univ., Baltimore, MD (United States). School of Hygiene and Public Health. Nov 1992. 5p. Sponsored by USDOE, Washington, DC (United States).

DOE Contract FG02-88ER60655. Order Number DE93003882. Source: OSTI; NTIS; GPO Dep.

Laboratory experimental studies were carried out to investigate the factors influencing the deposition of aerosols ranging in size from 1 nm to 10 μm in the human nasal, oral, pharyngeal and laryngeal airways. These experimental studies were performed in replicate upper airway physical models and in human volunteer subjects. New replicate models of the oral passage of an infant, the oral passage of an adult at two openings and the combined nasal and oral airways of an adult were constructed during the period, adding to the existing models of adult, child and infant nasal and oral airways models. Deposition studies in the adult oral and adult nasal models were performed under simulated cyclic flow conditions with 1 nm particles to compare with previously measured constant flow studies. Similar studies with inertial particles (1–10 μm diameter) were performed with the adult nasal model; in both instances, results with cyclic flow were similar to constant flow results using a simple average flow rate based on inspiratory volume and time of inspiration. Human subject studies were performed with particle sizes 5–20 nm for nasal inspiration; preliminary analysis shows good agreement with model studies at several representative flow rates. Nasal inspiratory inertial deposition of 1–4 μm diameter particles was measured in several adults as a function of airway dimensions; dimensional changes of the valve area by decongestion did not produce concomitant deposition changes.

4385 (DOE/MC/26018–93/C0111) **Toxicity studies of mild gasification products.** Ong, T.M.; Whong, W.Z.; Ma, J.; Zhong, B.Z.; Bryant, D. National Inst. for Occupational Safety and Health, Morgantown, WV (United States). [1992]. 14p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AI21-89MC26018. (CONF-920951–6: US Department of Energy contractors review meeting on gasification and gas stream cleanup systems, Morgantown, WV (United States), 15-17 Sep 1992). Order Number DE93002611. Source: OSTI; NTIS; GPO Dep.

The objectives of this project are: (1) to perform mutagenicity studies with the Ames Salmonella/microsomal assay system on coal liquids produced by mild gasification from different coals and/or processing conditions, (2) to determine whether coal liquids which are mutagenic to bacteria are also genotoxic to mammalian cells, (3) to establish correlations between mutagenicity, aromaticity, and boiling point range of coal liquids, and (4) to identify the chemical classes which are likely to be responsible for the mutagenic activity of gasification products. Four of the seven samples tested so far failed to demonstrate any mutagenic activity under any conditions tested. Those samples were SHELL#830331, MG-122IBP-420°F, MG-122 420–720°F, and MG-122 720°F+. Table 1 summarizes the results from all samples tested in DMSO and Tween 80. When solvated in DMSO, MG-119 and MG-120 composite materials displayed slight, but ultimately insignificant, genotoxic activity on TA98 and TA1OO in the presence of S9. When Tween 80 was used as the solvent, MG-119 and MG-120 displayed slight, but significant, geno-toxic activity on TA98 with S9 (Figure 4). CTC#11 in DMSO displayed significant genotoxic activity on both TA98 and TA1OO with and without S9. The activity was higher on TA98 than TA100, and higher with S9 than without, primarily indicating the presence of indirect-acting frameshift mutagen. The results of the testing on CTC#11 were similar for both solvents, DMSO and Tween 80 (Table 2).

4386 (ETDE-mf–93728954) **Histological and cytological differences between needles of healthy and damaged spruces at two sites in North-Rhine Westphalia, Germany. Final report.** Forschungsberichte zum Forschungsprogramm des Landes Nordrhein-Westfalen 'Luftverunreinigungen und Waldschaeden'. Rosenkranz, J.; Ebel, B.; Stratmann, U.; Ferfort, D.; Godde, D.; Niess, C.; Weber, M. Bochum Univ. (Germany). Zellmorphologie; Ministerium fuer Umwelt, Raumordnung und Landwirtschaft des Landes Nordrhein-Westfalen, Duesseldorf (Germany). Mar 1990 179p. (In German). Order Number DE93728954. Source: OSTI; NTIS (US Sales Only).

Cytological and histological characteristics of needles of damaged Norway spruce were compared with those of healthy trees. 122 parameters such as 'extension of the intercellular space', 'shape of chloroplast envelope', or 'silicium content of endodermis' have been examined. 94 of them revealed significant differences between the damaged needles and the non-damaged ones. Some of them depend on needle age, too. It was shown that 17 of the 94 significant differences are connected by regression with ozone, sulfur dioxide, or nitrogen dioxide. Ozone affects 'shape of the wax plugs of the stomates', 'relation of parenchyma area to needle cross section of trees in the Egge Mountains related to those of trees in the Rothaar Mountains', and 'number of damaged endodermis cells'. Sulfur dioxide affects 'shape of mesophyll cytoplasm' and 'thickness of granum thylakoid membrane'. Finally, nitrogen dioxide affects 'numbers of chloroplasts containing plastoglobules', 'relation of phosphorus concentration in mesophyll cell walls of trees related to trees, and 'inflated thylakoid space'. (orig./UWA).

4387 (KFK-PEF–80-Vol.1) **7th PEF status colloquium of March 5-7, 1991, Nuclear Research Center Karlsruhe.** Horsch, F.; Filby, W.G.; Fund, N.; Gross, S.; Hanisch, B.; Reinhardt, W.; Seidel, A. (comps.). Kernforschungszentrum Karlsruhe GmbH (Germany). Projekt Europaeisches Forschungszentrum fuer Massnahmen zur Luftreinhaltung (PEF). Apr 1991. 404p. (In German). (CONF-9103265–Vol.1: 7. annual report of the Research Program for Air Pollution Prevention Measures of Kernforschungszentrum Karlsruhe GmbH, Karlsruhe (Germany), 5-7 Mar 1991). Order Number DE93729025. Source: OSTI; NTIS (US Sales Only).

The research findings of Department 1a of PEF in 1990 are presented in 31 contributions, 25 of which are available as separate records in this database. The detection and analysis of airborve pollutants on forest ecosystems is described, and other possible causes of the new types of forest damage are gene into. Particular interest is taken in the soil factor. There are contributions on the effects of a multitude of abiotic environmental factors on the biodiversity of annelides, arthropodes, mycorrhizal fungi as well as on soil chemistry, the mineral substances balance, root mycorrhization, etc., and on tree germination and growth, annual ring width , photosynthesis rate and other physiological activities, biomass production, leaf constituents such as cations, aminoacid, carbohydrates, chlorophyll, etc. Methodical studies on remote mapping of forest damage and statistical evaluations of the single projects are presented as well. (UWA).

4388 (KFK-PEF–80-Vol.1, pp. 27-37) **CO_2-gas-exchange and transpiration of open grown Norway spruce during the year in higher elevations of the Southern Black Forest under local air conditions with and without O_3 respectively.** Abetz, P. (Freiburg Univ. (Germany). Inst. fuer Waldwachstum); Kuenstle, E.; Wolfart, A. Kernforschungszentrum Karlsruhe GmbH (Germany). Projekt Europaeisches Forschungszentrum fuer Massnahmen zur Luftreinhaltung (PEF). Apr 1991. (In German). (CONF-9103265–Vol.1: 7. annual report of the Research Program for Air Pollution Prevention Measures of Kernforschungszentrum Karlsruhe GmbH, Karlsruhe (Germany), 5-7 Mar 1991). In *7th PEF status colloquium of March 5-7, 1991, Nuclear Research Center Karlsruhe.* 404p. Order Number DE93729025. Source: OSTI; NTIS (US Sales Only).

Some parameter expressions for the year 1990 are presented including ground frost, soil humidity, tree rings, air temperature and radiation. Photoinhibition as well as higher night respiration and presumably higher light inhibition at the southern exposed twigs of the open grown Norway Spruce as compared to the northern exposed twigs were observed. The decrease in net photosynthesis at the south facing twigs was related to the heavy soil desiccation. Transpiration did decrease during the same period after an initial increase. Values for productivity were higher for the northern part of the tree as the southern part did recover slowly from summer stress. Cell division during that period was blotted out by its deswelling. Therefore, high radiation and soil desiccation during summer appear to be natural stress factors to Norway Spruce at higher elevations of the Southern Black Forest. There are no results regarding the effect of ozone on net photosynthesis and transpiration because of technical regarding the effect of ozone on net photosynthesis and transpiration because of technical problems. (orig./UWA).

4389 (KFK-PEF–80-Vol.1, pp. 39-47) **Immission measurements at Schoellkopf near Freudenstadt.** Baumbach, G. (Stuttgart Univ. (Germany). Inst. fuer Verfahrenstechnik

und Dampfkesselwesen); Baumann, K. Kernforschungszentrum Karlsruhe GmbH (Germany). Projekt Europaeisches Forschungszentrum fuer Massnahmen zur Luftreinhaltung (PEF). Apr 1991. (In German). Contract BMFT 0339112C. (CONF-9103265–Vol.1: 7. annual report of the Research Program for Air Pollution Prevention Measures of Kernforschungszentrum Karlsruhe GmbH, Karlsruhe (Germany), 5-7 Mar 1991). In *7th PEF status colloquium of March 5-7, 1991, Nuclear Research Center Karlsruhe.* 404p. Order Number DE93729025. Source: OSTI; NTIS (US Sales Only).

Since 1985, continuous measurements of air pollutants and meteorological data are carried out by the department of air pollution control (IVD) at the PEF research site 'Schoellkopf' near Freudenstadt (840 m asl). For this site, the typical air pollution situation was characterized at the 6th annual report of PEF in 1990. The results of the preceding years are updated in this report: In 1990 maximum SO_2 concentrations were registered in November and December, however this values did not reach the levels of January 1985, February 1986 and January 1987. Such significant high SO_2 concentrations are caused basically by long-range transport from north-easterly directions (EAST-Germany and CSFR), only. The maximum ozone half-hour-mean value was measured in August, whereas the highest monthly mean appeared in May like in the years before. In addition, it is reported on the behaviour of CO_2 above the forest canopy. The vertical distribution of ozone inside the forest stand was intensively investigated, and the ozone deposition on entire spruce branches was examined by means of the plant-enclosure-technique. (orig.).

4390 (KFK-PEF–80-Vol.1, pp. 49-70) **Physiological and biochemical investigations into the yellowing of spruce at higher altitudes. Pt. 4. Stability of the light-harvesting chlorophyll-a/b-protein, pigment content, activity of the xanthophyll cycle, and the sensitizing role of chlorophyll.** Siefermann-Harms, D. (Kernforschungszentrum Karlsruhe GmbH (Germany). Inst. fuer Genetik und Toxikologie). Kernforschungszentrum Karlsruhe GmbH (Germany). Projekt Europaeisches Forschungszentrum fuer Massnahmen zur Luftreinhaltung (PEF). Apr 1991. (In German). (CONF-9103265–Vol.1: 7. annual report of the Research Program for Air Pollution Prevention Measures of Kernforschungszentrum Karlsruhe GmbH, Karlsruhe (Germany), 5-7 Mar 1991). In *7th PEF status colloquium of March 5-7, 1991, Nuclear Research Center Karlsruhe.* 404p. Order Number DE93729025. Source: OSTI; NTIS (US Sales Only).

Physiological and biochemical investigations into the yellowing of spruce at higher altitudes.- Part IV: Stability of the light-harvesting chlorophyll-a/b-protein, pigment content, activity of the xanthophyll cycle, and the sensitizing role of chlorophyll. (1) In 1990, the investigations into pigment content of the needles and stability of the light-harvesting chlorophyll-a/b-protein (LHC) have been continued for slightly yellowing spruce trees (dammage class 0) of the PEF research site at Freudenstadt. The data support our earlier results. (2) The xanthophyll cycle was examined for spruce . The dark reactions of the cycle were inhibited for both, damaged spruce from Freudenstadt, and spruce from Essen-Kettwig exposed to 'clean-air conditions' but not for spruce exposed to 'industrial area conditions'. For Freudenstadt spruce, destabilization of the LHC occurred before the xanthophyll cycle was inhibited. (3) Experiments with a strongly chlorotic spruce at the Freudenstadt site showed that the red portion of sunlight (wavelengths > 600 nm) induces or inhibits the yellowing process, depending on photon flux density. Light-induced yellowing of damaged spruce appears to be sensitized by the excited chlorophyll molecule. (orig./UWA).

4391 (KFK-PEF–80-Vol.1, pp. 71-80) **Intermediates of carbohydrates and energy metabolism in spruce needles in relation to season and decline symptoms.** Einig, W. (Tuebingen Univ. (Germany). Physiologische Oekologie der Pflanzen); Egger, B.; Hampp, R. Kernforschungszentrum Karlsruhe GmbH (Germany). Projekt Europaeisches Forschungszentrum fuer Massnahmen zur Luftreinhaltung (PEF). Apr 1991. (In German). (CONF-9103265–Vol.1: 7. annual report of the Research Program for Air Pollution Prevention Measures of Kernforschungszentrum Karlsruhe GmbH, Karlsruhe (Germany), 5-7 Mar 1991). In *7th PEF status colloquium of March 5-7, 1991, Nuclear Research Center Karlsruhe.* 404p. Order Number DE93729025. Source: OSTI; NTIS (US Sales Only).

We analyzed annual changes of pool sizes of metabolites in three different age classes of needles of 8 about 40-year-old spruce trees with different symptoms of decline (Freudenstadt, Black Forest). Needle development and maturation was accompanied by decreasing ratios of ATP/ADP, fructose/glucose, and levels of fructose 2,6-bisphosphate (indicates increased rates of glycolysis) in the beginning of the vegetation period. This can be taken as evidence for increased rates of senescence in mature tissues. In addition, these needles tended to retain starch in November which suggests an impaired export capacity (sucrose levels wre not affected). This assumption is supported by the detection of structural defects in bundle cells. (orig.).

4392 (KFK-PEF–80-Vol.1, pp. 93-107) **Physiological and cytomorphological investigations of undamaged and damaged spruce in the Northern Black Forest.** Wild, A. (Mainz Univ. (Germany). Inst. fuer Allgemeine Botanik); Tietz, S. Kernforschungszentrum Karlsruhe GmbH (Germany). Projekt Europaeisches Forschungszentrum fuer Massnahmen zur Luftreinhaltung (PEF). Apr 1991. (In German). (CONF-9103265–Vol.1: 7. annual report of the Research Program for Air Pollution Prevention Measures of Kernforschungszentrum Karlsruhe GmbH, Karlsruhe (Germany), 5-7 Mar 1991). In *7th PEF status colloquium of March 5-7, 1991, Nuclear Research Center Karlsruhe.* 404p. Order Number DE93729025. Source: OSTI; NTIS (US Sales Only).

In damaged spruce the functional and structural status of thylakoid membranes seems to be affected. That is shown by a reduced content of chlorophyll as well as by reduced components of the thylakoid membrane (P-700, Cyt f, Cyt $b_5$63, Cyt $b_5$59, Q_B-protein). There is also a decrease of the electron transport rate. In contrast to that the antioxidative systems and some phenolic components are increased in damaged spruce. Ascorbate seems to play an important role to eliminate reactive oxygen species. An increase in PEPC activity and in the content of putrescine in damaged spruce indicate a considerable damage. The rise in dead cells in healthy needles of damaged spruce trees shows strong cell damage reactions. These physiological and biochemical findings in needles of damaged spruce are typical for the status of damaged reactions. These physiological and biochemical findings in needles of damaged spruce are typical for the status of damaged spruce with the signs of 'montane Vergilbung'. (orig.UWA).

4393 (KFK-PEF–80-Vol.1, pp. 109-119) **Genetic structures of forest trees with different levels of damage on permanent observation plots on forest decline in Baden-Wuerttemberg.** Konnert, M. (Forstliche Versuchs- und Forschungsanstalt Baden-Wuerttemberg, Freiburg im Breisgau (Germany). Abt. Botanik und Standortskunde). Kernforschungszentrum Karlsruhe GmbH (Germany). Projekt Europaeisches Forschungszentrum fuer Massnahmen zur Luftreinhaltung (PEF). Apr 1991. (In German). (CONF-9103265–Vol.1: 7. annual report of the Research Program for Air Pollution Prevention Measures of Kernforschungszentrum Karlsruhe GmbH, Karlsruhe (Germany), 5-7 Mar 1991). In *7th PEF status colloquium of March 5-7, 1991, Nuclear Research Center Karlsruhe.* 404p. Order Number DE93729025. Source: OSTI; NTIS (US Sales Only).

Genetic structures of forest trees with different levels of damage on permanent observation plots on forest decline in Baden-Wuerttemberg. The genetic structures of 961 damged silver fir trees (Abies alba Mill.) growing on 27 observation plots on forest decline in Baden- Wuerttemberg were studied by isozyme analysis. Four of nine loci studied were monomorphic in all populations. The different allele frequencies for five polymorphic loci indicate considerable amounts of genetic variation between the stands. There was no statistical evidence of linkage between average needle loss and genetic structures. Differences between tree subsets with extreme reactions (lowest needle loss, highest needle loss) within the populations were found at one gene locus at least. (orig./UWA).

4394 (KFK-PEF–80-Vol.1, pp. 121-131) **Detection of damages of trees with time resolved luminescence.** Schneckenburger, H. (Fachhochschule Aalen (Germany)); Schmidt, W. Kernforschungszentrum Karlsruhe GmbH (Germany). Projekt

Europaeisches Forschungszentrum fuer Massnahmen zur Luftreinhaltung (PEF). Apr 1991. (In German). (CONF-9103265–Vol.1: 7. annual report of the Research Program for Air Pollution Prevention Measures of Kernforschungszentrum Karlsruhe GmbH, Karlsruhe (Germany), 5-7 Mar 1991). In *7th PEF status colloquium of March 5-7, 1991, Nuclear Research Center Karlsruhe.* 404p. Order Number DE93729025. Source: OSTI; NTIS (US Sales Only).

The novel spectrophotometers and procedures monitoring both long term delayed luminescence (LDL) and picosecond fluorescence decay as employed for the first time in forest decline research and described in the 'PEF-status report 1990' have been further developed. Reliable data of picosecond fluorescence decay are available since Dec. 1989, of LDL-kinetics since May 1990. We report on results obtained with so-called 'open top chambers' which allow comparative measurements of spruces growing in environmental respectively in purified air. Similarly we present data obtained with spruces of various degree of decline as primarily defined in terms of needle-loss and yellowing. All measurements were exclusively performed with green, 'intact' specimen without visible damage rather than with already visibly damged samples. Significant dependencies on various factors such as location, environmental impact and degree of decline are unmistakable. In addition, as typical for physiological entities in general, all parameters measured exhibit a distinct and 'intrinisic' variation during the vegetation period, independend of the mentioned factors of impact. Therefore, the data obtained from one single, individual measurement cannot be correlated in an unique way with the physiological status of the tree serving as 'key parameter' for early diagnosis. (orig./UWA).

4395 (KFK-PEF–80-Vol.1, pp. 133-143) **Changes in photosynthetic activity, chlorophyll-fluorescence parameters and pigment content of differently damaged spruces during the vegetation period.** Rinderle, U. (Karlsruhe Univ. (T.H.) (Germany). Botanisches Inst. 2); Lichtenthaler, H.K. Kernforschungszentrum Karlsruhe GmbH (Germany). Projekt Europaeisches Forschungszentrum fuer Massnahmen zur Luftreinhaltung (PEF). Apr 1991. (In German). (CONF-9103265–Vol.1: 7. annual report of the Research Program for Air Pollution Prevention Measures of Kernforschungszentrum Karlsruhe GmbH, Karlsruhe (Germany), 5-7 Mar 1991). In *7th PEF status colloquium of March 5-7, 1991, Nuclear Research Center Karlsruhe.* 404p. Order Number DE93729025. Source: OSTI; NTIS (US Sales Only).

We performed investigations on photosynthetic activity, chlorophyll fluorescence and pigment content of differently damaged, 40 year old spruce trees. Stress and damage of trees/needles are preferentially indicated by lower values of the chlorophyll and carotenoid content, of the pigment ratio (a+b)/(x+c), the assimilation rate P_N/m^2, the stress- adaptation index Ap, the height of the saturation pulse spikes (g- h) of chlorophyll fluorescence and the fluorescence ratio (Fv)m/Fm. In contrast, the values of the non-photochemical quenching-coefficient qNP and the fluorescence ratio F690/F735 are much increased. The parameters of the in-vivo chlorophyll fluorescence were established as good indicators of the photosynthetic activity in addition to the CO_2 gas-exchange measurements. The differential development of damage or partial regeneration of the spruces is presented for the period of April 1989 to November 1990. The reduction and damage of photosynthesis, as caused by a combined light, temperature and ozone stress in June 1990, is presented. (orig./UWA).

4396 (KFK-PEF–80-Vol.1, pp. 145-155) **Reflectance spectra of leaves and needles as basis for the physiological evaluation of tree damage. Pt. 4. Composition of chlorophyll-protein-complexes and first estimation of biomass production.** Buschmann, C. (Karlsruhe Univ. (T.H.) (Germany). Lehrstuhl fuer Pflanzenphysiologie und Pflanzenbiochemie); Nagel, E.; Rang, S.; Stober, F.; Stuetzel, M. Kernforschungszentrum Karlsruhe GmbH (Germany). Projekt Europaeisches Forschungszentrum fuer Massnahmen zur Luftreinhaltung (PEF). Apr 1991. (In German). (CONF-9103265–Vol.1: 7. annual report of the Research Program for Air Pollution Prevention Measures of Kernforschungszentrum Karlsruhe GmbH, Karlsruhe (Germany), 5-7 Mar 1991). In *7th PEF status colloquium of March 5-7, 1991, Nuclear Research Center Karlsruhe.* 404p. Order Number DE93729025. Source: OSTI; NTIS (US Sales Only).

It is demonstrated that reflectance spectra and absorption spectra of spruce needles in the visible spectral range are influenced not only by the composition of leaf pigments (mainly chlorophyll-protein-complexes necessary for photosynthesis) but also by the structure of the needle tissue. Im damaged spruce trees changes in the composition of the chlorophyll-protein-complexes occur which can be deduced from the second derivative of the spectra. An estimation on biomass production from number, area and photosynthesic capacity of needles is presented. Obviously, the loss of older neddles and the decrease of photosynthesic capacity can partially be compensated by a stronger formation of younger needles and an enlargement of single needles. For the classification of the status of health of a tree we propose (a) to examine the composition of the chlorophyll-protein-complexes (measurement of reflectance and absorption spectra with the VIRAF-spectrometer) and (b) in parallel to estimate the biomass production by measuring the photosynthesic capacity (CO_2-porometer) and the number and area of needles (image analysis system). (orig.).

4397 (KFK-PEF–80-Vol.1, pp. 157-169) **Soil ciliates as indicators of fundamental changes in forest ecosystems.** Lehle, E. (Ulm Univ. (Germany). Abt. Oekologie und Morphologie der Tiere); Funke, W. Kernforschungszentrum Karlsruhe GmbH (Germany). Projekt Europaeisches Forschungszentrum fuer Massnahmen zur Luftreinhaltung (PEF). Apr 1991. (In German). (CONF-9103265–Vol.1: 7. annual report of the Research Program for Air Pollution Prevention Measures of Kernforschungszentrum Karlsruhe GmbH, Karlsruhe (Germany), 5-7 Mar 1991). In *7th PEF status colloquium of March 5-7, 1991, Nuclear Research Center Karlsruhe.* 404p. Order Number DE93729025. Source: OSTI; NTIS (US Sales Only).

The ciliate populations of various southern german soils were studied. The combined application of lime and mineral fertilizer led in field experiments to a substantial increase of active ciliates. Most species preferred a slightly acid to neutral environment in laboratory cultures. The substrates from the spruce forests of the lime-alpines, the deciduous forests and the orchard meadows were species rich. Strong acidified soils of struce forest were poor of species: Liming as well as liming in combination with lime-ammonnitric fertilization led, probably due to a activation of a latent species potential, to an increase in the species number. The succession of the species number in laboratory cultures in the substrate of the research areas SCHLUCHSEE (S) and VILLINGEN (V) showed all the same pattern. In V higher numbers of species were found 6 days after application at the fertilizes areas compared to the control areas. Ciliates are a very heterogenous group due to their trophic structure. The exological adaptation of serveral distinct species is described (orig./UWA).

4398 (KFK-PEF–80-Vol.1, pp. 171-183) **Multi-element analysis of invertebrate animals in the ecosystem 'spruce stand'.** Roth-Holzapfel, M. (Ulm Univ. (Germany). Abt. Oekologie und Morphologie der Tiere); Funke, W.; Rittner, P. Kernforschungszentrum Karlsruhe GmbH (Germany). Projekt Europaeisches Forschungszentrum fuer Massnahmen zur Luftreinhaltung (PEF). Apr 1991. (In German). (CONF-9103265–Vol.1: 7. annual report of the Research Program for Air Pollution Prevention Measures of Kernforschungszentrum Karlsruhe GmbH, Karlsruhe (Germany), 5-7 Mar 1991). In *7th PEF status colloquium of March 5-7, 1991, Nuclear Research Center Karlsruhe.* 404p. Order Number DE93729025. Source: OSTI; NTIS (US Sales Only).

Elementanalytical investigations have been carried out on invertebrate animals (Annelida, Arthropoda) of an 80-year-old monoculture of Norway spruce (Picea abies L. Karsten). The study site is situated at the southeast edge of the Swabian Alb, approximately 3 km northwest of Ulm. In the most important species of the invertebrate meso- and macrofauna (Lumbricidae, Enchytraeidae, Araneae, Oribatidae, Diplopoda, Collembola, Coleoptera, Hymenoptera, Diptera) the concentrations of 18 elements have been determined in dependance of the systematic and trophic level of the respective species. The data were screened for organisms being indicative for heavy metal pollution. The spectrum of elements included alkaline and earth- alkaline metals with macronutrient function, as well as essential and potentially toxic trace metals. In

addition the concentrations of P have been determined, as part of an anion ($PO^{-}4$), which constitutes a possible partner of metals in biochemical compounds. The concentrations of elements were measured by ICP-atomic emission spectroscopy (Al, Ba, Ca, Cu, Fe, K, La, Mg, Mn, Na, P, V, Zn) and flameless atomic aborption spectrometry (Cd, Co, Cr, Ni, Pb). (orig./UWA).

4399 (KFK-PEF–80-Vol.1, pp. 185-191) **Uptake and localization of nutritive and potentially toxic minerlas in ectomycorrhizae of forest trees.** Kottke, I. (Tuebingen Univ. (Germany). Inst. fuer Botanik, Spezielle Botanik, Mykologie); Oberwinkler, F. Kernforschungszentrum Karlsruhe GmbH (Germany). Projekt Europaeisches Forschungszentrum fuer Massnahmen zur Luftreinhaltung (PEF). Apr 1991. (In German). (CONF-9103265–Vol.1: 7. annual report of the Research Program for Air Pollution Prevention Measures of Kernforschungszentrum Karlsruhe GmbH, Karlsruhe (Germany), 5-7 Mar 1991). In *7th PEF status colloquium of March 5-7, 1991, Nuclear Research Center Karlsruhe.* 404p. Order Number DE93729025. Source: OSTI; NTIS (US Sales Only).

Uptake and localization of potentially toxic elements, especially aluminium, in mycorrhizas are investigated to clarify if mycorrhization results in effective detoxification of these elements. Localization and identification of elements is achieved by electron-energy-loss-spectroscopy (EELS) and imaging (ESI) on the TEM902, Zeiss. Aluminium had been found to be precipitated on the outside of rootlets and in polyphosphate droplets of hyphae. Several technical problems were further investigated. Barley roots were analyzed for aluminium deposition and aluminium was found in high amount on the root surface, the intercellular space and in polyphosphate droplets, which is shown here for the first time. Kryofixed, freeze-dried and embedded samples did not allow good sectioning for analysis up to now. Analysis of heavy metal deposition in mycorrhizas was started on material from plots and laboratory experiments. Observation of mycorrhizal development in rhizoscopes was continued on the plots Schloellkopf and ARINUS and samples taken for analysis. (orig./UWA).

4400 (KFK-PEF–80-Vol.1, pp. 205-216) **Project ARINUS: V. element cycling in the control watersheds and fertilizer leaching.** Brahmer, G. (Freiburg Univ. (Germany). Inst. fuer Bodenkunde und Waldernaehrungslehre); Feger, K.H.; Zoettl, H.W. Kernforschungszentrum Karlsruhe GmbH (Germany). Projekt Europaeisches Forschungszentrum fuer Massnahmen zur Luftreinhaltung (PEF). Apr 1991. (In German). (CONF-9103265–Vol.1: 7. annual report of the Research Program for Air Pollution Prevention Measures of Kernforschungszentrum Karlsruhe GmbH, Karlsruhe (Germany), 5-7 Mar 1991). In *7th PEF status colloquium of March 5-7, 1991, Nuclear Research Center Karlsruhe.* 404p. Order Number DE93729025. Source: OSTI; NTIS (US Sales Only).

The results of both measured and calculated element fluxed in the experimental watersheds SCHLUCHSEE and VILLINGEN are discussed. Using this information, we can distinguish between the amount of internal element fluxes within the ecosystem and external atmospheric input. The different amounts of internal and external fluxes are used to explain the degree of element output and the hydrochemical behavior of surface waters and groundwater. Net export from the watershed and net mobilization of elements in the watershed are balanced using estimations of annual elemental fixation by the stand, element fluxes in open land and canopy throughfall, total deposition, fixation by the stand biomass and watershed output. Despite similar atmospheric deposition of S and N, the turnover of both elements in the two study areas differs considerably. The different pattern of element output between these watersheds results from different retention and mobilization processes along their respective hydrological pathways. Potassium and $Mg^{2}+$ show only slight losses due to drainage export after fertilization, whereas output rates of applied S and N correspond to the different pattern of element cycling in the two study areas. (orig./UWA).

4401 (KFK-PEF–80-Vol.1, pp. 217-229) **Heavy metal budget of Norway spruce.** Trueby, P. (Freiburg Univ. (Germany). Inst. fuer Bodenkunde und Waldernaehrungslehre); Liu, J.C.; Zoettl, H.W. Kernforschungszentrum Karlsruhe GmbH (Germany). Projekt Europaeisches Forschungszentrum fuer Massnahmen zur Luftreinhaltung (PEF). Apr 1991. (In German). (CONF-9103265–Vol.1: 7. annual report of the Research Program for Air Pollution Prevention Measures of Kernforschungszentrum Karlsruhe GmbH, Karlsruhe (Germany), 5-7 Mar 1991). In *7th PEF status colloquium of March 5-7, 1991, Nuclear Research Center Karlsruhe.* 404p. Order Number DE93729025. Source: OSTI; NTIS (US Sales Only).

This investigation focussed on determining the distribution of biomass and heavy metals in relation to the age of Norway Spruce. To simulate the temporal changes of biomass a calculation model was developed. This model is also suitable for the calculation of heavy metal turnover by needle and twig fall and the estimation of the output by final harvest. The highest amount (up to 90% of the total) of heavy metals is stored in the wood of trees. This holds true for any age of trees. The amount stored in needles is generally lower than 5%. Only 10% of total lead is directly deposited from atmosphere. Most of the lead is taken up by roots. There is evidence that Cd and Zn are almost completely taken up from the soil. Both of the elements are probably leached from the bark. The heavy metal turnover by needle and twig fall is an essential component of the heavy metal budget of Norway spruce. There is an essential output of heavy metals by final harvest. With regard to Pb and Zn up 2/3 of the amount accumulated in the tree biomass is exported. However, in comparison with the total reserves of the soil the loss is very low, except for Zn. (orig./UWA).

4402 (KFK-PEF–80-Vol.1, pp. 241-252) **Mineral weathering and mineral destruction caused by acidification in forest stands of the Black Forest (Germany). First communication. Major aims and first results from the ARINUS stands 'Schluchsee and Villingen'.** Zarei, M. (Hohenheim Univ., Stuttgart (Germany). Inst. fuer Bodenkunde und Standortslehre); Stahr, K.; Papenfuss, K.H. Kernforschungszentrum Karlsruhe GmbH (Germany). Projekt Europaeisches Forschungszentrum fuer Massnahmen zur Luftreinhaltung (PEF). Apr 1991. (In German). (CONF-9103265–Vol.1: 7. annual report of the Research Program for Air Pollution Prevention Measures of Kernforschungszentrum Karlsruhe GmbH, Karlsruhe (Germany), 5-7 Mar 1991). In *7th PEF status colloquium of March 5-7, 1991, Nuclear Research Center Karlsruhe.* 404p. Order Number DE93729025. Source: OSTI; NTIS (US Sales Only).

Geochemical, micromorphological methods as well as X-ray diffractometry, X-ray fluorescence, scaning - as well as transmission -electron microscopy are used to follow mineral weathering, mineral newformation and mineral transformation in soils of the Black Forest. An examination of the actual amount of minerals in selected stands of the Black Forest will take place and will be compared with samples of the same profiles stored in archives. Furthermore some model experiments will take place to explain the changes observed. The results of X-ray diffractometry show in general an increase of secondary chlorites from the C-horizon towards the lower B-horizon of all examined profiles. The results are in agreement with the assumption of an effect of imported acidity on the weathering equilibria. (orig./UWA).

4403 (KFK-PEF–80-Vol.1, pp. 253-261) **Histological and histochemical investigations on the nutrient dynamics in forest trees with regard to the 'New-type forest decline'. Pt. 4. Binding forms and micromorphological distribution of calcium in spruce needles.** Fink, S. (Tuebingen Univ. (Germany). Lehrstuhl fuer Physiologische Oekologie der Pflanzen). Kernforschungszentrum Karlsruhe GmbH (Germany). Projekt Europaeisches Forschungszentrum fuer Massnahmen zur Luftreinhaltung (PEF). Apr 1991. (In German). (CONF-9103265–Vol.1: 7. annual report of the Research Program for Air Pollution Prevention Measures of Kernforschungszentrum Karlsruhe GmbH, Karlsruhe (Germany), 5-7 Mar 1991). In *7th PEF status colloquium of March 5-7, 1991, Nuclear Research Center Karlsruhe.* 404p. Order Number DE93729025. Source: OSTI; NTIS (US Sales Only).

Histological and histochemical investigations on the nutrient dynamics in forest trees with regard to the 'New-type Forest Decline'. IV. Binding forms and micromorphological distribution of calcium in spruce needles. The chemical binding forms of calcium in spruce needles from different sites were partitioned by sequential extraction of powdered needles into a water-soluble fraction (free Ca), an acetic acid- soluble fraction (Ca-pectate), and a hydrochloric acid-solubie fraction (Ca-oxalate); the amounts were determined

quantitatively at two dates in 1990. In addition, the micromorphological distribution of the last two fractions was determined by specific histochemical reactions on thin sections at the level of the light and electron microscope. The major amount of calcium in the needles proved to occur as Ca-oxalate, increasing absolutely and relatively with increasing needle age. The water-soluble fraction is smaller and independent of the Ca-supply from the soil, but changes during the year and with increasing needle age. Besides leaching of calcium from the outer epidermal cell walls under the impact of acidic deposition, unusual accumulations of Ca-oxalate crystals from the cell walls into the cells resp. within the vacuoles of epidermal and mesophyll cells were found in a number of spruce needles, possibly as a result of the impact of ozone. (orig./UWA).

4404 (KFK-PEF–80-Vol.1, pp. 273-284) **The dependence of the success of natural regeneration on upper soil conditions and degree of acidity in declined forest stands of the Black Forest.** Huss, J. (Freiburg Univ. (Germany). Waldbau-Inst.); Littek, T. Kernforschungszentrum Karlsruhe GmbH (Germany). Projekt Europaeisches Forschungszentrum fuer Massnahmen zur Luftreinhaltung (PEF). Apr 1991. (In German). (CONF-9103265–Vol.1: 7. annual report of the Research Program for Air Pollution Prevention Measures of Kernforschungszentrum Karlsruhe GmbH, Karlsruhe (Germany), 5-7 Mar 1991). In *7th PEF status colloquium of March 5-7, 1991, Nuclear Research Center Karlsruhe.* 404p. Order Number DE93729025. Source: OSTI; NTIS (US Sales Only).

{increasing acidification an nutrient deficiency caused by acid deposition.} In order to study the effects {of} especially of the upper soils, on germination and further development of the seedlings of 6 mountain tree species 4 test plots have been established in the Black Forest and also a parallel experiment in the greenhouse. The effects of additional site preparation and fertilization (and the effect of artificial acid rain) have been studied. On soils with high acidification an low nutrient contents negative effects on natural regeneration are to be expected: In many cases lower germination- and survival rates have been observed in comparision to better soil conditions. These effects were evident on all soils in the greenhouse without any fertilization but additional artificial rain, especially on the poorest upper soil. It was possible to decrease the damages by site preparation and also by liming. (orig./UWA).

4405 (KFK-PEF–80-Vol.1, pp. 285-294) **Statistical analysis of the physiological and biochemical data from the PEF research groups.** Urfer, W. (Dortmund Univ. (Germany). Fachbereich Statistik); Schaetzle, H. Kernforschungszentrum Karlsruhe GmbH (Germany). Projekt Europaeisches Forschungszentrum fuer Massnahmen zur Luftreinhaltung (PEF). Apr 1991. (In German). (CONF-9103265–Vol.1: 7. annual report of the Research Program for Air Pollution Prevention Measures of Kernforschungszentrum Karlsruhe GmbH, Karlsruhe (Germany), 5-7 Mar 1991). In *7th PEF status colloquium of March 5-7, 1991, Nuclear Research Center Karlsruhe.* 404p. Order Number DE93729025. Source: OSTI; NTIS (US Sales Only).

For pooling the physiological and biochemical data sets of all research groups a data bank is established as a prerequisite for statistical data analysis. By means of exclusion experiments the response with regard to all parameters can be analysed by non-parametric discriminant analysis. This procedure does not assume any specific kind of multivariate distribution of the data and has the advantage to find indicators that are specific signs for responses of plant metabolism in relation to loads of air pollutants. Because correlation does not imply causation, we discuss a particular model for causal inference. The statistical solution of the Fundamental Problem of Causal Inference replaces the impossible-to-observe causal effect of a treatment on a specific unit with the possible-to-estimate average causal effect of a treatment over a population of units. Finally we recommend the profile analysis for the investigation of the temporal dynamics of biochemical and physiological symptoms. (orig.).

4406 (KFK-PEF–80-Vol.1, pp. 309-319) **Experiment with exclusion of gaseous pollutants on spruce trees at Edelmannshof. Pt. B. Investigations on mineral cycling.** Seufert, G. (Umweltinstitut der Gemeinsamen Forschungsstelle der EG, Ispra (Italy)); Hoyer, V.; Evers, F.H. Kernforschungszentrum Karlsruhe GmbH (Germany). Projekt Europaeisches Forschungszentrum fuer Massnahmen zur Luftreinhaltung (PEF). Apr 1991. (In German). (CONF-9103265–Vol.1: 7. annual report of the Research Program for Air Pollution Prevention Measures of Kernforschungszentrum Karlsruhe GmbH, Karlsruhe (Germany), 5-7 Mar 1991). In *7th PEF status colloquium of March 5-7, 1991, Nuclear Research Center Karlsruhe.* 404p. Order Number DE93729025. Source: OSTI; NTIS (US Sales Only).

Mineral flowrates in waters passing the canopies have been monitored weekly for 4 years as possible indicators for pollutant deposition and mineral leaching. The results can be summarized as follows: Compared to trees in charcoal filtered air, the fluxes of manganese, calcium and magnesium per canopy surface are always enhanced in ambient air, the effects are more pronounced in winter than in summer seasons. The concentrations and fluxes of these cations are strongly related to sulfate. Potassium is only related to dissolved organic carbon (DOC). In parallel with decreasing SO_2-concentrations since 1986, the effects of charcoal filtering on mineral cycling are also decreasing. The needle and soil analysis indicated that the elevated leaching rates of nutrient cations were compensated by root uptake. The driving force for the leaching process was sulfur deposition, weather conditions which prolongated canopy wetting amplified the effects. (orig./UWA).

4407 (KFK-PEF–80-Vol.1, pp. 321-333) **Ecophysiological measurements on pollutant stressed trees - OTC Edelmannshof.** Schweizer, B. (Hohenheim Univ., Stuttgart (Germany). Inst. fuer Landeskultur und Pflanzenoekologie); Arndt, U. Kernforschungszentrum Karlsruhe GmbH (Germany). Projekt Europaeisches Forschungszentrum fuer Massnahmen zur Luftreinhaltung (PEF). Apr 1991. (In German). (CONF-9103265–Vol.1: 7. annual report of the Research Program for Air Pollution Prevention Measures of Kernforschungszentrum Karlsruhe GmbH, Karlsruhe (Germany), 5-7 Mar 1991). In *7th PEF status colloquium of March 5-7, 1991, Nuclear Research Center Karlsruhe.* 404p. Order Number DE93729025. Source: OSTI; NTIS (US Sales Only).

Measurements on spruce trees growing on natural site in open-top-chambers with charcoal- filtered and ambient air were continued. Further to the determination of diurnal courses of CO_2/H_2O gas exchange parameters under normal ambient conditions, measurements of the performance of photosynthetic apparatus were carried out by studies of light and CO_2 response curves on intact branches under controlled climatic conditions. The results indicate a lowered photosynthetic performance on youngest needle age class of spruce trees growing in ambient air from early summer 1990. More distinct effects appeared at the end of vegetation period. Beside reduced parameters indicating possible damages of mesophyll, spruce trees growing in ambient air showed markedly reduced relations between assimilation rate and stomatal conductance. Diurnal course measurements also showed higher transpiration rates in comparison with spruce trees growing in charcoal-filtered air. The results may be a hint for effects of air pollutants like ozone linked to drought. (orig./UWA).

4408 (KFK-PEF–80-Vol.1, pp. 335-344) **Open top chamber experiment 'Edelmannshof': Determination of biochemical parameters in needles of Norway spruce fumigated with unfiltered or charcoal-filtered air in comparison to untreated trees.** Egger, B. (Tuebingen Univ. (Germany). Physiologische Oekologie der Pflanzen); Braun, C.; Einig, W.; Hampp, R. Kernforschungszentrum Karlsruhe GmbH (Germany). Projekt Europaeisches Forschungszentrum fuer Massnahmen zur Luftreinhaltung (PEF). Apr 1991. (In German). (CONF-9103265–Vol.1: 7. annual report of the Research Program for Air Pollution Prevention Measures of Kernforschungszentrum Karlsruhe GmbH, Karlsruhe (Germany), 5-7 Mar 1991). In *7th PEF status colloquium of March 5-7, 1991, Nuclear Research Center Karlsruhe.* 404p. Order Number DE93729025. Source: OSTI; NTIS (US Sales Only).

Lyophilized needle homogenates, obtained from about 21-year-old spruce trees (Picea abies (L.) Karst.) are biochemically characterized in relation to the environmental conditions and their modification (Edelmannshof, Welzheimer Wald). The respective trees (2 for each treatment) were either kept in open-top chambers and fumigated with unfiltered or charcoal- filtered ambient air, or were experimentally not affected. Biochemical parameters assay are intermediates of energy (ATP,ADP) and carbohydrate

metabolism (here we focus on the regulation of carbon partitioning between starch and sucrose). The data represent needle samples collected between May 1989 and October 1990. Samples exposed to ambient air showed slightly increased pool sizes of sucrose and fructose 2,6-bisphosphate and an increased ratio of ATP/ADP. An increased ratio of ATP/ADP was also found in samples taken from the same trees between April 1987 and February 1989. This ratio could thus be indicative for a biochemical response to air constituents affecting metabolism at a stage were still no visible symptoms exist. (orig.).

4409 (KFK-PEF–80-Vol.1, pp. 345-364) **Biochemical and physiological investigations to detect effects of air pollutants on spruce in open-top-chambers.** Manderscheid, R. (Giessen Univ. (Germany). Inst. fuer Pflanzenoekologie); Schenk, U.; Jaeger, H.J. Kernforschungszentrum Karlsruhe GmbH (Germany). Projekt Europaeisches Forschungszentrum fuer Massnahmen zur Luftreinhaltung (PEF). Apr 1991. (In German). (CONF-9103265–Vol.1: 7. annual report of the Research Program for Air Pollution Prevention Measures of Kernforschungszentrum Karlsruhe GmbH, Karlsruhe (Germany), 5-7 Mar 1991). In *7th PEF status colloquium of March 5-7, 1991, Nuclear Research Center Karlsruhe.* 404p. Order Number DE93729025. Source: OSTI; NTIS (US Sales Only).

During the year 1990 despite high summer ozone levels no clear indication for air pollution effects could be found at the Edelmannshof site. Several components of antiocidative systems (ascorbate, glutathione; activity of ascorbate peroxidase) and of the nitrogen metabolism, which are known as early indicators of air pollution, have been measured. Significant differences between the trees of the clean and ambient air treatment have only been found with respect to the amino acid content. The spruces kept in the chambers with charcoal- filtered air contained higher levels of some amino acids from February till summer. It is discussed, whether this difference resulted from long-term effects of the reduction of the air pollution level or from the drought period occuring in 1989 an 1990. Small chamber effects on ascorbate,glutathione and glutamate/glutamine ratio continued in 1990. Measurements on diurnale changes of polyamine and amino acid content in early summer yielded fluctuations of the polyamine level in the range of about 30%. Single amino acids underwent strong diurnale changes. Some damaged trees contained higher activity levels of ascorbate peroxidase and superoxiddismutase during the early development of the new flush. (orig./UWA).

4410 (KFK-PEF–80-Vol.1, pp. 365-376) **Reference data of forest growth.** Kenk, G. (Forstliche Versuchs- und Forschungsanstalt Baden-Wuerttemberg, Freiburg im Breisgau (Germany). Abt. Waldwachstum). Kernforschungszentrum Karlsruhe GmbH (Germany). Projekt Europaeisches Forschungszentrum fuer Massnahmen zur Luftreinhaltung (PEF). Apr 1991. (In German). (CONF-9103265–Vol.1: 7. annual report of the Research Program for Air Pollution Prevention Measures of Kernforschungszentrum Karlsruhe GmbH, Karlsruhe (Germany), 5-7 Mar 1991). In *7th PEF status colloquium of March 5-7, 1991, Nuclear Research Center Karlsruhe.* 404p. Order Number DE93729025. Source: OSTI; NTIS (US Sales Only).

The project 'Reference Data of Forest Growth' examines if and to what extent present growth of the Norway spruce (Picea abies Karst.) differs from that of previous decades. Dendrometric measurements, some dating back to the last century, have been processed and compared with today's data. The present growth of the investigated spruce stands was never beneath that of the previous generation. On pooreer sites, growth during the last hundred years increased more than on the more fertile sites, where there was little or no increase. Possible couses of this increase are throught to be the combined effects of atmospheric deposition (especially nitrogen), a higher mineralization rate, CO_2-increase and climate. (orig./UWA).

4411 (KFK-PUG–4) **First annual report of the project 'Environment and health' on March 18 and 19, 1992, Nuclear Research Center Karlsruhe.** Horsch, F.; Friebel, P.; Seidel, A. (comps.). Kernforschungszentrum Karlsruhe GmbH (Germany). Projekt Umwelt und Gesundheit (PUG). Apr 1992. 220p. (In German). (CONF-9203204–: 1. annual report of the project environment and health of Kernforschungszentrum Karlsruhe GmbH (KfK), Karlsruhe (Germany), 18-19 Mar 1992). Order Number DE93728909. Source: OSTI; NTIS (US Sales Only).

On the 18th and 19th of March 1992 the First Status Report of the project 'Environment and Health' (PUG) took place at the Nuclear Research Center Karlsruhe. Progress reports on the following topics were presented: Correlation between air pollution and respiratory diseases; Illnesses caused by allergens and environmental pollutants in food. Separate entries were prepared from 13 papers out of 18. (orig./MG).

4412 (KFK-PUG–4, pp. 1-2) **Effects of outdoor and indoor air pollution on lung function, bronchial hyperreactivity, risk of pulmonary disease and course of disease.** Eltschka, R. (Medizinische Universitaetsklinik Freiburg (Germany). Abt. Pneumologie); Herceg, R.; Moseler, M.; Matthys, H. Kernforschungszentrum Karlsruhe GmbH (Germany). Projekt Umwelt und Gesundheit (PUG). Apr 1992. (In German). (CONF-9203204–: 1. annual report of the project environment and health of Kernforschungszentrum Karlsruhe GmbH (KfK), Karlsruhe (Germany), 18-19 Mar 1992). In *First annual report of the project 'Environment and health' on March 18 and 19, 1992, Nuclear Research Center Karlsruhe.* 220p. Order Number DE93728909. Source: OSTI; NTIS (US Sales Only).

The effect of outdoor exposure to SO_2, NO_2, ozone, and particulate pollutants on pulmonary function and respiratory discomfort was studied over a period of 1 1/2 yr in 133 non smoking adults. The weekly mean individual outdoor pollutants were analysed for all 133 participants with regard to habitation and place of work. The analyses of the longitudinal study shows a significant correlation between daily peakflow measurements and ozone levels in patients with symptomatic asthma bronchiale (SAB) and chronic obstructive pulmonary disease (COPD). For pollen, SO_2, NO_2 and anorganic particulate pollutants we did not find any significant effects on peak expiratory flow measurements. On the basis of these results which are supported by several experimental ozone studies it appears advisable to lower the present limits for maximal ozone levels (200 $\mu g/m^3$) in Germany. (orig./MG).

4413 (KFK-PUG–4, pp. 37-47) **The effect of ozone inhalation on the airway response to inhaled allergens.** Joerres, R. (Krankenhaus Grosshansdorf, Zentrum fuer Pneumologie und Thoraxchirurgie (Germany)); Nowak, D.; Magnussen, H. Kernforschungszentrum Karlsruhe GmbH (Germany). Projekt Umwelt und Gesundheit (PUG). Apr 1992. (In German). (CONF-9203204–: 1. annual report of the project environment and health of Kernforschungszentrum Karlsruhe GmbH (KfK), Karlsruhe (Germany), 18-19 Mar 1992). In *First annual report of the project 'Environment and health' on March 18 and 19, 1992, Nuclear Research Center Karlsruhe.* 220p. Order Number DE93728909. Source: OSTI; NTIS (US Sales Only).

In this study we address the question whether breathing of ozone affects the airway responsiveness to inhaled allergens. We investigate groups of subjects with different state of their allergic disease (seasonal allergic rhinitis without pulmonary complaints, seasonal allergic asthma with pulmonary complaints, healthy controls). Within the groups, ozone sensitive subjects are selected according to their functional response during experimental exposure to ozone. These preselected subjects are exposed to clean air of 0.25 ppm ozone during intermittent exercise on two different days. We measure lung function and airway responsiveness to methacholine before and after exposure, and airway responsiveness to an inhaled allergen is determined after each exposure. By this approach, we can assess the relationship between the disease of the subjects, the effects of ozone on lung function, and its effects on airway responsiveness. Our study will contribute to the problem whether the airway response to an inhaled allergen and the manifestation of pulmonary symptoms after allergen exposure can be modulated by prior exposure to ozone. (orig.).

4414 (KFK-PUG–4, pp. 49-60) **Effect of exposure to ozone and subsequent infection with respiratory syncytial virus (RSV) on alveolar macrophage functions and immune responses to inhaled antigen.** Freihorst, J. (Kinderklinik der Medizinischen Hochschule Hannover, Abt. Paediatrische Pneumologie (Germany)); Hardt, H. v.d.; Franke, G.; Muhle, H.; Lohmann-Matthes, M. Kernforschungszentrum Karlsruhe GmbH (Germany). Projekt Umwelt und Gesundheit (PUG). Apr 1992. (In

German). (CONF-9203204--: 1. annual report of the project environment and health of Kernforschungszentrum Karlsruhe GmbH (KfK), Karlsruhe (Germany), 18-19 Mar 1992). In *First annual report of the project 'Environment and health' on March 18 and 19, 1992, Nuclear Research Center Karlsruhe.* 220p. Order Number DE93728909. Source: OSTI; NTIS (US Sales Only).

Using an animal model (BALB/c-mice) we investigate the combined effect of an exposure to ozone and subsequent respiratory infection with Respiratory Syncytial Virus (RSV). Groups of BALB/c-mice were exposed to ozone (0.5 ppm, 6 hrs/day) or clean air for 2 wks, and subsequently infected with RSV, $5x10^4$ PFU/dose intranasally (I/N). From day 4 to day 8 after infection (p.i.) the animals received I/N doses of ovalbumin (OVA) with Alum-adjuvant. At different intervals bronchioalveolar lavage (BAL) was performed, alveolar macrophages were separated and assessed for secretion of mediators IL-1, IL-6, Prostaglandin E2 (PGE2) and Tumor Necrosis Factor (TNF). Serum samples were obtained at day 28 p.i. and assessed for OVA-specific IgG- and IgE-antibodies by ELISA. While ozone exposure alone did not alter measured parameters as compared to control animals, alveolar macrophages isolated from RSV-infected mice showed increased production of IL-6, PGE2, and TNF; further enhancement was seen in the group exposed to ozone prior to infection. A significant increase in IL-1 production was only seen in the ozone exposed and RSV-infected group. These animals also had significant higher OVA-specific antibody titers in their serum compared to all other groups. (orig./MG).

4415 (KFK-PUG–4, pp. 61-75) **Studies of pathophysiologic and pathomorphologic effects of inhalative exposure to low concentrations of the air pollutants NO_2 and SO_2 on the epithelium of trachea, submucosal tracheal glands and peripheral airways in the rat.** Wagner, U. (Marburg Univ. (Germany). Medizinische Poliklinik); Amon, D.; Kimpel, C.; Saalmann, R.; Wichert, P. von; Barth, P.J. Kernforschungszentrum Karlsruhe GmbH (Germany). Projekt Umwelt und Gesundheit (PUG). Apr 1992. (In German). (CONF-9203204--: 1. annual report of the project environment and health of Kernforschungszentrum Karlsruhe GmbH (KfK), Karlsruhe (Germany), 18-19 Mar 1992). In *First annual report of the project 'Environment and health' on March 18 and 19, 1992, Nuclear Research Center Karlsruhe.* 220p. Order Number DE93728909. Source: OSTI; NTIS (US Sales Only).

Male Sprague-Dawley rats were exposed alternatively to 5, 10 and 20 ppm NO_2 and SO_2 the exposure-time being 3 or 25 days respectively. Studies by means of the Ussing-chamber-technique (radiolabelling mucins with ^{35}S) clearly demonstrated a concentration dependant modulation of mucus secretion. Exposure to increasing concentrations of the pollutants produced significant rises of basal and stimulated secretion. Compared to each other the NO_2-exposed animals all together displayed lower secretory levels than did the SO_2-exposed ones. 25 day's exposure rather caused moderately higher secretion rates than 3 day's exposure. The concentration seems to be of major influence than the duration of exposure. Pathomorphologic effects of exposure to both pollutants were quantified measuring the wall thickness of bronchioli respiratorii and alveolar septa by semiautomatic image analysis. 10 and 20 ppm NO_2 caused significant concentration-dependant increases of both parameters whereas 5 ppm was without effect compared to controls. SO_2 could not be demonstrated to act on alveolar septa, but produced a significant rise of wall thickness in bronchioli respiratorii at concentrations of 20 ppm. Moreover the number of nuclolar organizer regions (AgNOR) was assessed by automated image analysis as a marker of regenerative activity in the epithelium of main stem bronchi and bronchioli respiratorii. Significant concentration dependant increases of AgNOR number could be demonstrated due to NO_2-exposure with a different distribution pattern between main stem bronchi and bronchioli respiratorii, the latter showing significant alterations already due to lower concentrations as does the former. Thus AgNOR-analysis, proves to be a valuable and sensitive tool for the assessment of regenerative activity epithelium due to even low concentrations of the pollutants. (orig./MG).

4416 (KFK-PUG–4, pp. 77-102) **Characterization of surfactant apoproteins after damage of alveolar tissue caused by exposure with NO_2, and their pathogenetic role in toxic lung injury.** Mueller, B. (Marburg Univ., Pneumologisches Forschungslabor der Medizinischen Poliklinik (Germany)); Mengel, R.G.; Wichert, P. von. Kernforschungszentrum Karlsruhe GmbH (Germany). Projekt Umwelt und Gesundheit (PUG). Apr 1992. (In German). (CONF-9203204--: 1. annual report of the project environment and health of Kernforschungszentrum Karlsruhe GmbH (KfK), Karlsruhe (Germany), 18-19 Mar 1992). In *First annual report of the project 'Environment and health' on March 18 and 19, 1992, Nuclear Research Center Karlsruhe.* 220p. Order Number DE93728909. Source: OSTI; NTIS (US Sales Only).

We now for the first time studied the in vivo alterations (10 ppm, 72 hours) of the SP-A after nitrogen dioxide inhalation and compared it to in vitro exposure effects (5 and 10 ppm, 4 h). Exposure of rat SP-A to nitrogen dioxide showed, (1) a higher pool size after in vivo exposure, (2) a slightly decreased mannose binding capacity for the in vivo exposed form, but a highly decreased binding after in vitro exposure, (3) an affected protein-lipid aggregation that was impaired most by the in vitro exposed protein, (4) a low inhibition for the secretion of phosphatidylcholine in isolated type II pneumocytes, (5) no difference in apparent molecular weight and immunological reactivity of the differently exposed SP-A. The nitrogen dioxide induced alterations of the surfactant protein A may contribute to the pulmonary toxicity of this oxidant. It is clear from this study that the extend of the effects from in vivo and in vitro exposure are different. Therefore both forms of exposure are necessary to assess the biological significance of nitrogen dioxide exposure. Besides SP-A β-adrenergic agents play an important role as candidates for surfactant metabolism control in vivo. After in vivo exposure to NO_2 (5 ppm, 48 h) surfactant phospholipid metabolism was changed when analyzed in the model of the isolated, ventilated and perfused rat lung: (1) cells from lung lavage showed an increase in phosphatidylcholine contents, percentage of phosphatidylcholines and incorporation of ^3H-palmitate. Incorporation of palmitic acid was stimulated both in healthy and NO_2 exposed rats by β-agopnist in vitro, whereas for ^{14}C-choline this was only possible in healthy animals, (2) after NO_2 exposure lung tissue showed an increase in phospholipid contents and a reduced percentage of sphingomyelin. Incorporation of ^3H-palmitate and ^{14}C-choline remained unchanged after NO_2 inhalation as well as β-adrenergic stimulation. (orig./MG).

4417 (KFK-PUG–4, pp. 103-113) **Results of a chronic inhalation with N-nitrosodimethylamine (NDMA) and SO_2/NO_x.** Klein, R.G. (Deutsches Krebsforschungszentrum, Heidelberg (Germany). Inst. fuer Toxikologie und Chemotherapie); Hermann, R.; Janowsky, I.; Zeller, W.J.; Schmezer, P.; Edler, L.; Amelung, F. Kernforschungszentrum Karlsruhe GmbH (Germany). Projekt Umwelt und Gesundheit (PUG). Apr 1992. (In German). (CONF-9203204--: 1. annual report of the project environment and health of Kernforschungszentrum Karlsruhe GmbH (KfK), Karlsruhe (Germany), 18-19 Mar 1992). In *First annual report of the project 'Environment and health' on March 18 and 19, 1992, Nuclear Research Center Karlsruhe.* 220p. Order Number DE93728909. Source: OSTI; NTIS (US Sales Only).

We will present the results of a chronic carcinogenicity bioassay performed to discern combination effects of the environmental toxicants SO_2 and NO_x and the carcinogenic NDMA at low concentrations. On the basis of previous in vitro experiments this study was carried out by exposing female Sprague-Dawley rats lifelong with the chemicals by inhalation. A high tumor incidence occurred in the nasal region of all NDMA-exposed rats and a significant decrease in survival was observed compared to control animals and animals exposed to SO_2 and NO_x only. The overall tumor rate in the target organ (nasal epithelium) was not influenced by the additional inhalation of SO_2 or NO_x and showed values of more than 90% in the NDMA-groups. Becase of this surprisingly high tumor rate, it was not possible to apply methods of prevalence analysis. However, the differences in the malignancy of nasal tumors were found to be statistically significant between NDMA-treated groups (NDMA: 2 carcinomas, NDMA + SO_2: 11, NDMA + NO_x: 8). The carcinomas of the NDMA + NO_x-group showed the shortest median tumor induction time (536 days) compared to carcinomas of the other groups (NDMA: 631, NDMA + SO_2: 714). In animals without nitrosamine exposure no tumors of the nasal epithelium were observed. Also, no tumors of the lower respiratory tract or the

lungs were found in any group. The rate of neoplasia in other organs than the nose was similar to values of spontaneous tumors reported in the literature. In order to confirm this possible trend that malignancy increases with the simultaneous SO_2 or NO_x exposure, additional experimental data are needed from tests performed at lower nitrosamine concentrations and with larger groups of animals. (orig./MG).

4418 (KFK-PUG–4, pp. 115-124) **Metabolic changes of human lung fibroblasts after exposure to ozone.** Mayer, D. (Thoraxklinik Heidelberg-Rohrbach (Germany)); Vogt-Moykopf, I. Kernforschungszentrum Karlsruhe GmbH (Germany). Projekt Umwelt und Gesundheit (PUG). Apr 1992. (In German). (CONF-9203204–: 1. annual report of the project environment and health of Kernforschungszentrum Karlsruhe GmbH (KfK), Karlsruhe (Germany), 18-19 Mar 1992). In *First annual report of the project 'Environment and health' on March 18 and 19, 1992, Nuclear Research Center Karlsruhe.* 220p. Order Number DE93728909. Source: OSTI; NTIS (US Sales Only).

Previous investigations demonstrated elevated concentrations of hyaluronate (HA) in culture media of human lung fibroblasts after their exposure to 0,5 ppm ozone for 20 h; in one cell line, HA synthesis had been enhanced. These results were interpreted against the background of fibrotic alteration of lung tissues. Northern-blot-hybridizations using a cDNA probe containing the gene of the preproα2(I)-chain for collagen I suggest reduced transcription of that gene in cultivated cells after exposure to 0,5 ppm for 20 h. However, sample size does not yet permit final conclusions. No transcription of the preproα2(I) gene for collagen I could be assayed in RNA from solid lung tissue. (orig./MG).

4419 (KFK-PUG–4, pp. 125-136) **Investigations on lucigenin-enhanced chemiluminescence of alveolar macrophages following exposure to exogenous noxious agents.** Zeller, W.J. (Deutsches Krebsforschungszentrum, Heidelberg (Germany)); Brehm, M.; Schiller, E. Kernforschungszentrum Karlsruhe GmbH (Germany). Projekt Umwelt und Gesundheit (PUG). Apr 1992. (In German). (CONF-9203204–: 1. annual report of the project environment and health of Kernforschungszentrum Karlsruhe GmbH (KfK), Karlsruhe (Germany), 18-19 Mar 1992). In *First annual report of the project 'Environment and health' on March 18 and 19, 1992, Nuclear Research Center Karlsruhe.* 220p. Order Number DE93728909. Source: OSTI; NTIS (US Sales Only).

Alveolar macrophages lavaged from bovine lungs using Ca^{2+} and Mg^{2+}-deprived saline containing EGTA for calcium chelation were cultivated in RPMI-1640 medium. Lucigenin-enhanced chemiluminescence was measured using a LB 9505 C Biolumat (Berthold) following exposure of cells to micronized quartz. The present report is mainly focussed on methodical problems and results (e.g. optimal cell number, dosage of quartz and metal salts). There was a dose related increase in chemiluminescence following exposure to quartz. The efficiency of cells following exposure to quartz alone or in combination with metal salts was monitored by exposure to a second stimulus using phorbol-12-myristate-13-acetate (PMA). Our results indicate that the combination of quartz plus Fe^{2+}- or Fe^{3+}-salts resulted in a significant damage of cell function. (orig.).

4420 (KFK-PUG–4, pp. 137-147) **Dust induced stimulation of reactive oxygen species release in bovine alveolar macrophages.** Gercken, G. (Hamburg Univ. (Germany). Abt. fuer Biochemie und Molekularbiologie); Berg, I.; Schlueter, T. Kernforschungszentrum Karlsruhe GmbH (Germany). Projekt Umwelt und Gesundheit (PUG). Apr 1992. (In German). (CONF-9203204–: 1. annual report of the project environment and health of Kernforschungszentrum Karlsruhe GmbH (KfK), Karlsruhe (Germany), 18-19 Mar 1992). In *First annual report of the project 'Environment and health' on March 18 and 19, 1992, Nuclear Research Center Karlsruhe.* 220p. Order Number DE93728909. Source: OSTI; NTIS (US Sales Only).

Alterations of reactive oxygen intermediates (ROI) release were studied after incubation of bovine alveolar macrophages (BAM) with different dusts and metal ions. Dust fractions of city waste and sewage fludge incineration, a power station ash, a mineral dust, a metal dust, and quartz dusts were used. Incubation of BAM with the dusts caused an increasing secretion of ROI, which was found to be concentration dependent. The metal containing dusts were analyzed for their element contents by AAS and AES-ICP. H_2O_2-secretion correlates best with the elements Fe, Mn, Cr, V, As, Co, and Si. Time course experiments (15 to 90 min) revealed an increased ROI release already after an incubation time of 15 min lasting for the whole investigated period. Fe^{3+} (1 μM), but not Fe^{2+} (1 μM - 100 μM) enhanced the quartz dust induced release of ROI. Omission of Ca^{2+} and Mg^{2+} in the stimulation buffer containing quartz dust diminished ROI release to control values. Incubation with Mg^{2+} alone decreased the quartz response to about 60%. In accordance, cytometric monitoring of intracellular Calcium values showed a dust induced calcium transient, which disappeared in the absence of extracellular Ca^{2+} and Mg^{2+}. Moreover, replenishing Ca^{2+} in the stimulation buffer restored the $[Ca^{2+}]_i$ transient. (orig.).

4421 (KFK-PUG–4, pp. 149-161) **Combined effects of gases and particles on alveolar macrophages in vitro.** Polzer, G. (Kernforschungszentrum Karlsruhe GmbH (Germany). Inst. fuer Genetik und Toxikologie); Mosbach, M.; Matejka, M.; Lind, I.; Schmidt, A.; Seidel, A.; Mayer, D. Kernforschungszentrum Karlsruhe GmbH (Germany). Projekt Umwelt und Gesundheit (PUG). Apr 1992. (In German). (CONF-9203204–: 1. annual report of the project environment and health of Kernforschungszentrum Karlsruhe GmbH (KfK), Karlsruhe (Germany), 18-19 Mar 1992). In *First annual report of the project 'Environment and health' on March 18 and 19, 1992, Nuclear Research Center Karlsruhe.* 220p. Order Number DE93728909. Source: OSTI; NTIS (US Sales Only).

Bovine alveolar macrophages (BAM) were exposed in vitro to Ozone or NO_2 by a gas phase culture technique. Ozone alone (2.5 ppm, 2 h) induced the release of Tumor Necrosis Factor (TNF) and of a chemotactic factor for alveolar macrophages. The viability of the cells remained normal. Previous phagocytosis of latex (250 μg/ml) or quartz (50 μg/ml) had no additional effects. The chemoattractant activity in the culture supernatants is thermolabile, and can be reduced by pretreatment of the BAM with Actinomycin D or addition of antibodies to C5. Inhibitors for release of Prostaglandins or Leucotriene B_4 had no effect. NO_2 in high concentration (3.5 ppm, 4 h) had an influence on the cell morphology and reduced viability. The LPS- and Zymosan-triggered release of ChF and O_2^- was reduced after NO_2 exposure. By slight modifications of the exposure techniques also calcitriol-differentiated HL60-cells could be exposed in gas phase. These cells produce TNF and O_2^- upon stimulation with the usual agents and show chemotactic migration. (orig.).

4422 (KFK-PUG–4, pp. 163-174) **Studies on the detection of toxic, genotoxic and carcinogenic effects induced by exposure to heavy metals.** Schmezer, P. (Deutsches Krebsforschungszentrum, Heidelberg (Germany). Inst. fuer Toxikologie und Chemotherapie); Klein, R.G.; Pool-Zobel, B.L. Kernforschungszentrum Karlsruhe GmbH (Germany). Projekt Umwelt und Gesundheit (PUG). Apr 1992. (In German). (CONF-9203204–: 1. annual report of the project environment and health of Kernforschungszentrum Karlsruhe GmbH (KfK), Karlsruhe (Germany), 18-19 Mar 1992). In *First annual report of the project 'Environment and health' on March 18 and 19, 1992, Nuclear Research Center Karlsruhe.* 220p. Order Number DE93728909. Source: OSTI; NTIS (US Sales Only).

The current report summarizes our experiments on the detection of genotoxic effects induced by $CdSO_4$ and $Na_2Cr_2O_7$ in the respiratory tract of rats. The assays were performed by incubating primary suspension cultures of rat lung cells and nasal mucosa cells with the chemicals or by analysing these cells immediately after their isolation from rats which had been exposed to the chemicals during short-term inhalation studies. Cytotoxic and DNA-damaging effects were detected by dye exclusion and electrophoresis techniques, respectively. $CdSO_4$ as well as $Na_2Cr_2O_7$ induced DNA-damage within these cells after their in vitro incubation with the test chemicals, whereby the effects were more pronounced in lung cells than in nasal mucosa cells. Following in vivo inhalation of aerosols, both heavy metal compounds were genotoxic in the lung, but our results so far revealed only $CdSO_4$ to clearly induce DNA-damage in the nasal mucosa. These results will be discussed in context with preliminary data on the bioavailability of the chemicals in lung, liver, kidney, and in nasal lavage

following inhalation exposure. Finally, the outline of a chronic inhalation study (combination of $CdSO_4$ and N-nitrosodimethylamine) will be described. (orig.).

4423 (KFK-PUG–4, pp. 175-189) **Matrix structures in preneoplasias and lung tumours. Correlation to environmental noxes.** Mueller, K.M. (Berufsgenossenschaftliche Krankenanstalten Bergmannsheil, Bochum (Germany). Inst. fuer Pathologie); Fisseler-Eckhoff, A. Kernforschungszentrum Karlsruhe GmbH (Germany). Projekt Umwelt und Gesundheit (PUG). Apr 1992. (In German). (CONF-9203204–: 1. annual report of the project environment and health of Kernforschungszentrum Karlsruhe GmbH (KfK), Karlsruhe (Germany), 18-19 Mar 1992). In *First annual report of the project 'Environment and health' on March 18 and 19, 1992, Nuclear Research Center Karlsruhe.* 220p. Order Number DE93728909. Source: OSTI; NTIS (US Sales Only).

The examinations finished in the first part of our research project led to the following results: 1. 7 months after tracheal application of asbestos fibres in animal experiments, adenoid dysplasias with cellular atypias comparable to human preneoplasias could be demonstrated. The degree of epithelial atypia was histochemically qualified by the help of reproducable increase in expression of nucleolar organizing regions in human preneoplasias as well as in experimentally induced ones. 2. Immunohistochemical and electromicroscopical examinations of collagenous and non-collagenous matrix structures proved evidence of both destruction and poor production of collagenous and non-collagenous structures of the basement membran in parabasal areas of dysplasias. 3. By the help of non-radioactive in situ hybridisation with probes made of laminin and collagen, the expression of matricial proteins was demonstrable not only in connective tissue cells but also in epithelial cells of pneumocytes type II. 4. Correlations between malignant lung tumours manifested differently concerning histomorphology and phenotype and environmental noxes qualified both quantitatively and qualitatively such as chrome, nickel and asbestos, led to no reproducable noxes-specific results in comparison to other so-called tumour noxes. To sum it up, the results gained in the examinations reinforce the hypothesis claiming multi-genetic defects to be responsable for the development of manifest malignant tumours. Tumours develop via different degrees of dysplasias depending on different environmental noxes, which often act on in a synchronic or additive way. (orig.).

4424 (LBL–32636) **Risk factors for work-related symptoms in northern California office workers.** Mendell, M.J. Lawrence Berkeley Lab., CA (United States). Oct 1991. 113p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC03-76SF00098. Order Number DE93000637. Source: OSTI; NTIS; GPO Dep.

In most episodes of health complaints reported in office buildings in the last-twenty years, causal factors have not been identified. In order to assess risk factors for work-related symptoms in office workers, a reanalysis was performed of previous studies, and an epidemiologic study was conducted. The reanalysis of data, showed remarkable agreement among studies. Air-conditioned buildings were consistently associated with higher prevalence of headache, lethargy, and eye, nose, or throat problems. Humidification was not a necessary factor for this higher prevalence. Mechanical ventilation without air-conditioning was not associated with higher symptom prevalence. A study was conducted among 880 office workers, within 12 office buildings selected without regard to worker complaints, in northern California. A number of factors were found associated with prevalence of work-related symptoms, after adjustment in a logistic regression model for personal, psychosocial, job, workspace, and building factors. Two different ventilation types were associated with increases Ln symptom prevalence, relative to workers in naturally ventilated buildings: mechanical supply and exhaust ventilation, without air conditioning and with operable windows; and air-conditioning with sealed windows. No study buildings were humidified. In both these ventilation types, the highest odds ratios (ORs) found were for skin symptoms (ORs-5.0, 5.6) and for tight chest or difficulty breathing (ORs-3.6, 4.3). Use of carbonless copies or photocopiers, sharing a workspace, carpets, new carpets, new walls, and distance from a window were associated with symptom increases. Cloth partitions and new paint were associated with symptom decreases.

4425 (PNL–8302-Vol.1) **Ecological evaluation of proposed discharge of dredged material from Oakland Harbor Into ocean waters (Phase 3 A of -42-foot project): Volume 1, Analyses and discussion.** Ward, J.A. (Battelle/Marine Sciences Lab., Sequim, WA (United States)); Word, J.Q.; Pinza, M.R.; Mayhew, H.L.; Barrows, E.S.; Lefkovitz, L.F. Pacific Northwest Lab., Richland, WA (United States). Sep 1992. 169p. Sponsored by Department of Defense, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE92041335. Source: OSTI; NTIS; GPO Dep.

The Battelle/Marine Sciences Laboratory (MSL) conducted a study to detemine whether dredged sediments from Oakland Inner and Outer Harbors were, suitable for ocean disposal. Nineteen test treatments, six reference treatments, and control treatments were tested for physical/chemical parameters, water column effects, dredged sediment-toxicity, and bioaccumulation potential. Physical/chemical parameters were analyzed at each site and each composite sediment to a depth of -44 ft MLLW. These parameters included analysis for geological characteristics, conventional sediment measurements (grain size, total volatile solids, total organic carbon, oil and grease, and total petroleum hydrocarbons), metals, polynuclear aromatic hydrocarbons (PAHs), pesticides, butyltins, and polychlorinated biphenyls (PCBs). Physical/chemical data were used in support of the toxicological and bioaccumulation testing, but were not used in the decision-making criteria described iti the Draft Implementation Manual under Tier III testing. To evaluate water column effects, MSL conducted suspended-particulate-phase (SPP) tests using the mysid shrimp Holmesimysis sculpta, speckled sanddab Citharichtys stigmaeus, and larvae of the pacific oyster Crassostrea gigas- Both a 48-h and a 96-h test were performed. The MSL evaluated dredgedsediment toxicity by conducting a total of eight solid-phase toxicity tests using the following organisms: the bivalve clam Macoma nasuta, the polychaste worm Nepthys caecoides, the speckled sanddab C. stigmaeus, and the arnphipod Rhepoxynius abronius. Test duration ranged From 10 to 28 days. Bioaccumulation potential was evaluated in the 28-day M. nasuta and N. caecoides solid-phase exposures by measuring the Contaminants of concern present in their tissues after exposure to test, reference, and control sediments.

4426 (PNL–8302-Vol.2) **Ecological evaluation of proposed discharge of dredged material from Oakland Harbor Into ocean waters (Phase 3 A of -42-foot project): Volume 2, Appendixes.** Ward, J.A. (Battelle/Marine Sciences Lab., Sequim, WA (United States)); Word, J.Q.; Pinza, M.R.; Mayhew, H.L.; Barrows, E.S.; Lefkovitz, L.F. Pacific Northwest Lab., Richland, WA (United States). Sep 1992. 685p. Sponsored by Department of Defense, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE92041139. Source: OSTI; NTIS; INIS; GPO Dep.

The Battelle/Marine Sciences Laboratory (MSL) conducted a study to determine whether dredged sediments from Oakland Inner and Outer Harbors were suitable for ocean disposal. Nineteen test treatments, six reference treatments, and three control treatments were tested for physical/chemical parameters, water column effects, dredged- sediment toxicity, and bioaccumulation potential. Physical/chemical parameters were analyzed at each site and each composite sediment to a depth of -44 ft MLLW. These parameters included analysis for geological characteristics, conventional sediment measurements (grain size, total volatile solids, total organic carbon, oil and grease, and total petroleum hydrocarbons), metals,, polynuclear aromatic hydrocarbons (PAHs), pesticides, butyltins, and polychlorinated biphenyls (PCBs). Physical/chemical data were used in support of the toxicological and bioaccumulation testing, but were not used in the decision-making criteria described in the Draft Implementation manual under Tier III testing. To evaluate water column effects, MSL conducted suspended-particulate-phase (SPP) test using the mysid shrimp Holmesimysis sculpta, speckled sanddab citharichtys stigmaeus, and larvae of the pacific oyster Crassostrea gigas. Both a 48-h and a 96-h test were performed. The MSL evaluated dredged-sediment toxicity by conducting a total of eight solid-phase toxicity tests using the following organisms: the bivalve clam Macoma nasuta, the polychaete worm Nepthys

caecoides, the speckled sanddab C. stigmaeus, and the amphipod Rhepoxynius abronius. Test duration ranged from 10 to 28 days. Bioaccumulation potential was evaluated in the 28-day M. Nasuta and N. caecoides solid-phase exposures by measuring the contaminants of concern present in their tissues after exposure to test, reference, and control sediments. This report contains the data and test results.

4427 (RFP–4502) **Plating factors affecting the beryllium antibody assay, statistical and graphical analyses.** Clarke, S.M.; Thurlow, S.M. EG and G Rocky Flats, Inc., Golden, CO (United States). Rocky Flats Plant. 5 Oct 1992. 16p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC34-90DP62349. Order Number DE93003116. Source: OSTI; NTIS; INIS; GPO Dep.

The beryllium antibody assay uses vacuum deposition to anchor the antigen, beryllium, onto 96 microsticks located on the lids of 96-well immunological plates. In the plating process, three major parameters (time, height from beryllium source, and current) can be changed. By statistical and graphical analyses, the effects of these parameters on the anchoring phenomenon were examined. Ninety seconds, seven inches, and 160 milliamps were found to yield the optimum anchoring characteristics. Use of these parameters established reproducibility of the assay on different plates over time.

4428 (WSRC-RP–92-923) **Results of the F/H Effluent Treatment Facility biological monitoring program, July 1987–July 1991.** Specht, W.L. Westinghouse Savannah River Co., Aiken, SC (United States). Jul 1992. 8p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC09-89SR18035. Order Number DE93001893. Source: OSTI; NTIS; INIS; GPO Dep.

As required by the South Carolina Department of Health and Environmental Control (SCDHEC) under NPDES Permit SCO000175, biological monitoring was conducted in Upper Three Runs Creek to determine if discharges from the F/H Effluent Treatment Facility have adversely impacted the biotic community of the receiving stream. Data included in this summary report encompass July 1987 through July 1991. As originally designed, the F/H ETF was not expected to remove all of the mercury from the wastewater; therefore, SCDHEC specified that studies be conducted to determine if mercury was bioaccumulating in aquatic biota. Subsequent to approval of the biological monitoring program, an ion exchange column was added to the F/H ETF specifically to remove mercury, which eliminated mercury from the F/H ETF effluent. The results of the biological monitoring program indicate that at the present rate of discharge, the F/H ETF effluent has not adversely affected the receiving stream with respect to any of the parameters that were measured. The effluent is not toxic at the in-stream waste concentration and there is no evidence of mercury bioaccumulation.

5604 Other Environmental Pollutant Effects

4429 (DOE/RA/50219–T23) **Effects of 60-Hz electric and magnetic fields on operant and social behavior and on neuroendocrine system of nonhuman primates: Draft final report, October 1, 1988–December 31, 1992.** Rogers, W.R.; Coelho, A.M.; Easley, S.P.; Orr, J.L.; Reiter, R.J.; Rhodes, J.W. Southwest Research Inst., San Antonio, TX (United States). 24 Sep 1992. 10p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC02-80RA50219. Order Number DE93002641. Source: OSTI; NTIS; GPO Dep.

A series of pioneering electric and magnetic field experiments were completed using nonhuman primates and a unique, well-engineered, and reliable exposure facility. Effects of operant behavior, social behavior, and serum melatonin concentration were examined using 60 Hz field combinations of other 6 W/m and 0.6 G or 30 W/m and 1.0 G. Observations noted in the course of this study include: Combines electric and magnetic field exposure does not have any important effect on short-term memory; the transitory increases in social behavior observed in previous electric fields did not occur; combined electric and magnetic field exposure might lead to reduced behavioral frequency in baboon social groups; three experiments clearly establish that one set of exposure conditions does not produce molatonin suppression in nonhuman primates; and a small pilot experiment suggests that a different exposure protocol might result in melatonin suppression.

4430 (DOE/RA/50219–T25) **Investigation of effects of 60-Hz electric and magnetic fields on operant and social behavior and on the neuroendocrine system of nonhuman primates: Social behavior portions of Experiments III and IV: Quarterly report No. 39.** Rogers, W.R.; Rhodes, J.W. Southwest Research Inst., San Antonio, TX (United States). Dept. of Biosciences and Bioengineering. 1 Sep 1992. 38p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC02-80RA50219. Order Number DE93002762. Source: OSTI; NTIS; GPO Dep.

A cohort of sixteen male baboons were assigned to electric and magnetic field (E/MF) exposure and sham-exposure. The social behavior subjects were simultaneously exposed to 60 Hz E/MF. Ten behavioral categories were measured. Each behavioral category was comprised of multiple molecular behaviors that could be objectively identified and counted. Six of the behavior categories were "social", in that interactions between subjected were involved. The remaining four were "non-social" and pertained to individual behaviors such as movements or postural stances.

4431 (DOE/RA/50219–T26) **Investigation of effects of 60-Hz electric and magnetic fields on operant and social behavior and on the neuroendocrine system of nonhuman primates: Quarterly report 40, Operant behavior: Experiments 3, 4, and 4A.** Rhodes, J.W. Southwest Research Inst., San Antonio, TX (United States). 24 Sep 1992. 215p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC02-80RA50219. Order Number DE93002763. Source: OSTI; NTIS; GPO Dep.

The objective of this program is to investigate behavioral and neuroendocrine effects associated with exposure to 60-Hz electric and magnetic fields (E/MF), using the baboon (Papio cynocephalus) as a nonhuman primate surrogate for the human. Results from this program, along with information from experiments conducted elsewhere, could be used to estimate and evaluate the likelihood of deleterious consequences of human exposure to the electric and magnetic fields associated with electric power transmission. This report covers a series of three experiments (Experiments III, IV, and IVA) on the effect of combined 60-Hz E/MF on operant behavior. These experiments were a continuation of previous investigations of 60-Hz electric field exposure on baboons.

4432 (KFK-PUG–4, pp. 5-14) **Influence of air pollution on the airways of children. Summary of effects of air pollutants and positive predictive analyses of skin sensibilisation.** Forster, J. (Universitaetskinderklinik Freiburg (Germany)); Kramer-Hendel, A.; Weiss, K.; Moseler, M.; Kuehr, J.; Urbanek, R.; Karmaus, W. Kernforschungszentrum Karlsruhe GmbH (Germany). Projekt Umwelt und Gesundheit (PUG). Apr 1992. (In German). (CONF-9203204–: 1. annual report of the project environment and health of Kernforschungszentrum Karlsruhe GmbH (KfK), Karlsruhe (Germany), 18-19 Mar 1992). In *First annual report of the project 'Environment and health' on March 18 and 19, 1992, Nuclear Research Center Karlsruhe.* 220p. Order Number DE93728909. Source: OSTI; NTIS (US Sales Only).

In 1991 the main emphasis of our analysis was put on the results of skin-prick-tests. Concerning following epidemiologic studies the size of wheal diameter was of great interest, because a definition for the cut-off-limit and the prognostic significance of the wheal size in the development of allergic deseases in children is discussed. Our analysis show that also small wheal diameters, which were not noted as significant up to now, have a positive predictive value for the incidence of allergic symptoms. In this study it was not possible to define a cut-off-limit between the incidence risk for allergy in probands with negative prick test results vs. probands with positive results. We conclude that in further epidemiologic studies all skin prick test results must be carefully considered in the analysis. (orig.).

57 HEALTH AND SAFETY

Refer also to citation(s) 2843, 3533, 3973, 4786

4433 (PNL–8385) **Evaluation of Machine Guarding pilot course taught in Idaho Falls, Idaho, June 23, 1992–June 25, 1992.** Wright, T.S. Pacific Northwest Lab., Richland, WA (United States). Oct 1992. 16p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE93002974. Source: OSTI; NTIS; GPO Dep.

This report summarizes trainee evaluations for the Safety Training Section course, Machine Guarding which was conducted June 23–25 at the Westinghouse Idaho Nuclear Company, in Idaho Falls, Idaho. This class was the fourth pilot course taught. Also, this report summarize the quantitative course evaluations that trainees provided upon completion of the course. Appendix A provides a transcript of the trainees' written comments. This class was conducted concurrently with a "Supervisors Orientation to Occupational Safety in DOE" class. This allowed the lead instructor to use two experts in the classes without additional cost. The experiment was successful, both from a standpoint of cost and quality. The same format (concurrent classes) will be used at the Nevada test site in October.

5701 Real Accidents

Refer also to citation(s) 4103, 4357

58 GEOSCIENCES

Refer also to citation(s) 2599, 2622, 2777, 2819, 2821, 3389, 3390, 3451, 3452, 3737, 3739, 3740, 3741, 3742, 3743, 3744, 3745, 3746, 3747, 3748, 3749, 3750, 3758, 3769, 4096, 4113, 4119, 4137, 4170, 4174, 4179, 4191, 4194, 4196, 4237, 4244

4434 (DOE/ER/13711–T1) **Anistotropic yielding of rocks at high temperatures and pressures: Final report.** Kronenberg, A.K.; Russell, J.E.; Carter, N.L. Texas A and M Univ., College Station, TX (United States). Center for Tectonophysics. 14 Oct 1990. 15p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG05-87ER13711. Order Number DE93004363. Source: OSTI; NTIS; GPO Dep.

The anisotropic deformation of foliated and linealed rocks has been investigated, primarily to predict the mechanical response of rocks surrounding buried magma chambers to the stress fields generated by deep drilling. The principal application in this regard has been to evaluate, the scientific feasibility of extracting geothermal energy from buried magma chambers. Our approach has been to perform triaxial extension and compression tests at temperatures and pressures representative of the borehole environment on samples cored along six selected orientations and to fit the data to an orthohombric yield criterion. We have investigated Four-Mile gneiss (a strongly layered gneiss with well defined lineation), a biotite-rich schist, and Westerly granite (using a block oriented with respect to the granite's rift, grain, and hardway). Progress has been made in three areas: the experimental determination of strength anisotropies for the three starting materials, theoretical treatment and modeling of the results, and characterization of fabrics surrounding magma bodies resulting from their diaperic emplacement into shallow portions of the Earth's crust. In addition, results have been obtained for the tensile fracture of quartzite, basal slip and anisotropy of biotite single crystals, and anisotropic flow of bedded rocksalt.

4435 (DOE/ER/14079–21) **Dip-movement processing for depth-variable velocity.** Artley, C.T. Colorado School of Mines, Golden, CO (United States). Center for Wave Phenomena. Dec 1992. 48p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG02-89ER14079. (CWP–115). Order Number DE93004454. Source: OSTI; NTIS; GPO Dep.

Dip-moveout correction (DMO) has become commonplace in the seismic processing flow. The goal of DMO processing is to transform the NMO-corrected data to zero-offset, so that the application of zero-offset (poststack) migration is equivalent to full prestack migration of the recorded data. Nearly all DMO implementations assume that the seismic velocity is constant. Usually, this is an acceptable tradeoff because of the tremendous cost savings of DMO and poststack migration versus prestack migration. Where the velocity changes rapidly with depth, however, this constant velocity theory can yield inadequate results. For many areas, such as the Gulf Coast, a velocity function that varies with depth is a reasonable approximation to the true velocity field. Using ray tracing, I find the raypaths from the source and receiver to the reflection point with the given recording time. The time along the corresponding zero-offset ray gives the DMO correction. The relationships between the three rays are expressed by a system of nonlinear equations. By simultaneously solving the equations via Newton-Raphson iteration, I determine the mapping that transforms nonzero-offset data to zero-offset. Unlike previous schemes that approximately handle vertical velocity variation, this method makes no assumptions about the offset, dip, or hyperbolic moveout.

66 PHYSICS

6611 Classical and Quantum Mechanics

Refer also to citation(s) 4468, 4724

4436 (IC–92/178) **Three lectures on quantum groups: Representations, duality, real forms.** Dobrev, V.K. International Centre for Theoretical Physics, Trieste (Italy). Jul 1992. 34p. Order Number DE93608159. Source: OSTI; NTIS (US Sales Only); INIS.

Quantum groups appeared first as quantum algebra, i.e. as one parameter deformations of the numerical enveloping algebras of complex Lie algebras, in the study of the algebraic aspects of quantum integrable systems. Then quantum algebras related to triparametric solutions of the quantum Yang-Baxter equation were axiomatically introduced as (pseudo) quasi-triangular Hopf algebras. Later, a theory of formal deformations has been developed and the notion of quasi-Hopf algebra has been introduced. In other approaches to quantum groups the objects are called quantum matrix groups and are Hopf algebras in chirality to the quantum algebras. The representations of $U_q(G)$, the chirality and the real forms associated to these approaches are discussed here. Refs.

4437 (IC–92/188) **Q-deformed conformal superalgebra and its Hopf subalgebras.** Dobrev, V.K. (International Centre for Theoretical Physics, Trieste (Italy)); Lukierski, J.; Sobczyk, J.; Tolstoy, V.N. International Centre for Theoretical Physics, Trieste (Italy). Jul 1992. 19p. Order Number DE93608160. Source: OSTI; NTIS (US Sales Only); INIS.

We present in detail a Hopf superalgebra $U_q(su(2,2/2))$ which is a q-deformation of the conformal superalgebra su(2,2/1). The superalgebra $U_q(su(2,2/1))$ contains as a subalgebra a q-deformed super-Poincare algebra and as Hopf subalgebras two conjugate 16-generator q-deformed super-Weyl algebras, which are q-deformation of parabolic subalgebras of su(2,2/1). We use several (anti-) involutions, including the standard Cartan involution and a *-antiinvolution under which the super-Weyl algebras are *-subalgebras of $U_q(su(2,2/1))$. The q-deformed Lorentz algebra is Hopf subalgebra of both Weyl algebras and is preserved by all (anti-) involutions considered. (author). 26 refs.

4438 (IC–92/194) **Calculations of wavefunctions and energies of electron system in Coulomb potential by variational method without a basis set.** Bykov, V.P. (International Centre for Theoretical Physics, Trieste (Italy)); Gerasimov, A.V. International Centre for Theoretical Physics, Trieste (Italy). Aug 1992. 17p. Order Number DE93608161. Source: OSTI; NTIS (US Sales Only); INIS.

A new variational method without a basis set for calculation of the eigenvalues and eigenfunctions of Hamiltonians is suggested. The expansion of this method for the Coulomb potentials is given. Calculation of the energy and charge distribution in the two-electron system for different values of the nuclear charge Z is made. It is shown that at small Z the Coulomb forces disintegrate the electron cloud into two clots. (author). 3 refs, 4 figs, 1 tab.

4439 (IC–92/214) **Information-theoretic outlook of the quantum dissipation problem.** Kowalski, A.M. (Centro Regional Norte Univ. de Buenos Aires, Buenos Aires (Argentina). Grupo de Sistemas Dinamicos); Plastino, A.; Proto, A.N. International Centre for Theoretical Physics, Trieste (Italy). Aug 1992. 20p. Order Number DE93608162. Source: OSTI; NTIS (US Sales Only); INIS.

The interaction between two harmonic oscillators, a classical and a quantum one, coupled through a linear term, is analyzed by recourse to the generalized Ehrenfest theorem. The model is able to mimic dissipating behaviour for the quantum oscillator without violation of any quantum rule. (author). 13 refs, 5 figs.

4440 (IC–92/215) **Nth roots with Hilbert-Schmidt defect operator of normal contractions.** Duggal, B.P. International Centre for Theoretical Physics, Trieste (Italy). Aug 1992. 19p. Order Number DE93608163. Source: OSTI; NTIS (US Sales Only); INIS.

Let T be a normal contraction (on a complex separable Hilbert space H into itself) with an nth root A such that the defect operator $D_A=(1-A^*A)^{1/2}$ is of the Hilbert-Schmidt class C_2. Then either A is normal or A is similar to a normal contraction. In the case in which T is hyponormal, $A^n=T$ and D_A is an element of C_2, A is a "coupling" of a contraction similar to a normal contraction and a contraction which is the quasi-affine transform of a unilateral shift. These results are applied to prove a (Putnam-Fuglede type) commutatively theorem for operator valued roots of commutative analytic functions and hyponormal contractions T which have an nth root with Hilbert-Schmidt defect operator. 23 refs.

4441 (IC–92/217) **The three-body problem in the ground-state representation.** Gonzalez, A. International Centre for Theoretical Physics, Trieste (Italy). Aug 1992. 16p. Order Number DE93608164. Source: OSTI; NTIS (US Sales Only); INIS.

The ground-state probability density of the 3B system is used to construct a classical potential, U, whose minimum coincides exactly with the ground-state energy. The spectrum of excited states may be approximately obtained by imposing quasiclassical quantization conditions over the classical motion on U. We show a nontrivial one dimensional model in which this quantization condition proves to be exact. For tridimensional problems, the small oscillation frequencies in states with total angular momentum L=0 are computed. These frequencies should represent an improvement over the frequencies of triatomic molecules computed using ordinary quasiclassics for the motion of the nuclei in the molecular term. By providing a semiclassical description of the first quantum excited states, the sketched approach raises some interesting questions such as, for example, the relevance (once again!) of classical chaos to Quantum Mechanics. (author). 22 refs.

4442 (IC–92/232) **Dynamical groups of a particle in a periodic potential.** Yusuf, M. International Centre for Theoretical Physics, Trieste (Italy). Sep 1992. 8p. Order Number DE93608165. Source: OSTI; NTIS (US Sales Only); INIS.

Solving the Schroedinger non-relativistic equation of a particle moving under the influence of the potential $V(\theta) = \omega(1 - \cos\theta)$ leads to us to the standard Mathieu equation. Jahnke-Emde's(1938), the periodic solutions are Mathieu functions of even order. With an approximation we study two important limiting cases, a simple quantum rotator and one-dimensional linear oscillator. We show the dynamical groups of these special, and a further study of the real problem connects us an Euclidean group of 2D. An IRR of matrix elements give us the energy levels. The interface between the E_2 and Bessel Functions is showed. (author). 7 refs.

4443 (IC–92/239) **Information-theoretic and Wigner function approaches to the nonclassical states dynamics for the variable frequency harmonic oscillator.** Aliaga, J. (Buenos Aires Univ., CRN, Buenos Aires (Argentina). Grupo de Sistemas Dinamicos); Crespo, G.; Proto, A.N. International Centre for Theoretical Physics, Trieste (Italy). Sep 1992. 9p. Order Number DE93608166. Source: OSTI; NTIS (US Sales Only); INIS.

Coherent and squeezed states for the time-dependent frequency harmonic oscillator are analysed using Maximum Entropy Principle techniques. The information-theoretic procedure leads to results equivalent to that of the Wigner function formalism, although the former gives a physical interpretation of the involved parameters and allows for a non-zero temperature density matrix. (author). 6 refs.

4444 (INIS-BR–2945) **The three-body problem in quantum mechanics.** Antunes, A.C.B. Universidade Federal, Rio de Janeiro, RJ (Brazil). Coordenacao dos Programas de Pos-graduacao de Engenharia. 1973 132p. (In Portuguese). Order Number DE93608167. Source: OSTI; NTIS (US Sales Only); INIS.

Different methods used in the analysis of the scattering of an elementary particle by a system of two bound particles are compared. All particles are considered spinless and distinguishable from each other. Two approaches are used in the treatment of the problem. In the first method we build an effective - potential which accounts for the interaction of the incident particle with the bound system. The second approach consists in treating the target as a system of two particles, whose momentum distribution is given by the bound state wavefunction. The three body system is then treated by the techniques of the multiple scattering series and of Glauber theory. (author).

4445 (INP–1553/PH) **On the generalization of Medvedev approach to classical mechanics.** Bochnacki, P.; Horzela, A.; Kapuscik, E.; Kempczynski, J. Institute of Nuclear Physics, Cracow (Poland). Jun 1991. 21p. Order Number DE93608168. Source: OSTI; NTIS (US Sales Only); INIS.

The many body systems, called Medvedev systems, for which the momentum of each body depends on velocities of all other bodies are considered. The notion of singular Medvedev systems is introduced and their properties are reviewed. (author).

4446 (INP–1556/PH) **On the Galilean covariance of classical mechanics.** Horzela, A. (Institute of Nuclear Physics, Cracow (Poland)); Kapuscik, E.; Kempczynski, J. Institute of Nuclear Physics, Cracow (Poland). Aug 1991. 50p. Order Number DE93608169. Source: OSTI; NTIS (US Sales Only); INIS.

A Galilean covariant approach to classical mechanics of a single interacting particle is described. In this scheme constitutive relations defining forces are rejected and acting forces are determined by some fundamental differential equations. It is shown that total energy of the interacting particle transforms under Galilean transformations differently from the kinetic energy. The statement is illustrated on the exactly solvable examples of the harmonic oscillator and the case of constant forces and also, in the suitable version of the perturbation theory, for the anharmonic oscillator. (author).

4447 (INP–1557/PH) **On Galilean covariant quantum mechanics.** Horzela, A. (Institute of Nuclear Physics, Cracow (Poland)); Kapuscik, E.; Kempczynski, J. Institute of Nuclear Physics, Cracow (Poland). Aug 1991. 26p. Order Number DE93608170. Source: OSTI; NTIS (US Sales Only); INIS.

Formalism exhibiting the Galilean covariance of wave mechanics is proposed. A new notion of quantum mechanical forces is introduced. The formalism is illustrated on the example of the harmonic oscillator. (author).

4448 (INT–242/PS) **The fast algorithm solving the one-dimensional time-dependent Schroedinger equation for teaching purposes.** Skoczen, A.; Machowski, W.; Kaprzyk, S. Institute of Physics and Nuclear Techniques, Cracow (Poland). Jul 1990. 28p. (In Polish). Order Number DE93608171. Source: OSTI; NTIS (US Sales Only); INIS.

Computer program aiming at application in quantum mechanics didactics has been proposed. This program can generate the moving pictures of one-dimensional quantum mechanics scattering phenomena. Constructions of this program provide two options. In the first option the wave packet is generated in infinite one-dimensional well which has walls on the borders of graphic window. In the second option the square potential barrier is located in this well and transmission and reflection of wave packet are shown. We have selected a Gaussian wave packet to represent the initial state of the particle. The wave equation is solved numerically by a method discussed in detail. Solutions for the succesive time moments are graphically presented on the monitor screen. In this way observer can watch whole time-development of physical system. Graphically presented results are physically realistic when program parameters satisfy conditions discussed in this paper. (author).

4449 (LBL–32101) **Decoherence of multimode thermal squeezed coherent states.** Yeh, L. Lawrence Berkeley Lab., CA (United States). 14 Aug 1992. 15p. Sponsored by USDOE, Washington, DC (United States); National Science Foundation, Washington, DC (United States). DOE Contract AC03-76SF00098.

Grant PHY-90-21139. (CONF-9203181–2: Workshop on harmonic oscillators, Baltimore, MD (United States), 25-28 Mar 1992; UCB-PTH–92/07). Order Number DE93002627. Source: OSTI; NTIS; INIS; GPO Dep.

It is well known that any multimode positive definite quadratic Hamiltonian can be transformed into a hamiltonian of uncoupled harmonic oscillators. Based on this theorem, the multimode thermal squeezed coherent states are constructed in terms of density operators. Decoherence of multimode thermal squeezed coherent states in investigated via the characteristic function and it is shown that the decohered (reduced) states are still thermal squeezed coherent states in general.

4450 (SAND–92-0866C) **Constitutive and equation of state models using object-oriented programming methods.** Wong, M.K.W.; Peery, J.S.; Budge, K.G. Sandia National Labs., Albuquerque, NM (United States). [1992]. 12p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-76DP00789. (CONF-9209240–1: Society of Engineering Science (SES) technical meeting, San Diego, CA (United States), 14-16 Sep 1992). Order Number DE93000740. Source: OSTI; NTIS; GPO Dep.

Large-scale simulations of solid dynamics problems require sophisticated computer hardware, employing specialized or unique features to enhance performance. The developer of computational mechanics codes is not only faced with the task of programming the necessary analysis algorithms, but also of ensuring that the available system capabilities are properly utilized to obtain the highest possible performance. Developing and maintaining the code for a number of computers, ranging from single processor serial workstations to massively parallel vectorized supercomputers, becomes a very difficult, potentially intractable problem. In this paper, we present an approach that seeks to minimize this problem by applying object-oriented programming (OOP) concepts to the development of the RHALE++ hydrodynamics/solid mechanics code that is written in the C++ language. In particular, we use the OOP paradigm to facilitate code development, maintenance, and portability of constitutive and equation of state models.

6612 Techniques of General Use in Physics

Refer also to citation(s) 3954

4451 (SAND–92-1938C) **Fundamentals of high energy electron beam generation.** Turman, B.N.; Mazarakis, M.G.; Neau, E.L. Sandia National Labs., Albuquerque, NM (United States). [1992]. 13p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-76DP00789. (CONF-9209238–1: American Welding Society (AWS) meeting, Cambridge, MA (United States), 21-23 Sep 1992). Order Number DE93000745. Source: OSTI; NTIS; GPO Dep.

High energy electron beam accelerator technology has been developed over the past three decades in response to military and energy-related requirements for weapons simulators, directed-energy weapons, and inertially-confined fusion. These applications required high instantaneous power, large beam energy, high accelerated particle energy, and high current. These accelerators are generally referred to as "pulsed power" devices, and are typified by accelerating potential of millions of volts (MV), beam current in thousands of amperes (KA), pulse duration of tens to hundreds of nanoseconds, kilojoules of beam energy, and instantaneous power of gigawatts to teffawatts (10^9 to 10^{12} watts). Much of the early development work was directed toward single pulse machines, but recent work has extended these pulsed power devices to continuously repetitive applications. These relativistic beams penetrate deeply into materials, with stopping range on the order of a centimeter. Such high instantaneous power deposited in depth offers possibilities for new material fabrication and processing capabilities that can only now be explored. Fundamental techniques of pulse compression, high voltage requirements, beam generation and transport under space-charge-dominated conditions will be discussed in this paper.

4452 (SINS–2104/P-5/PP/A) **Laboratory facility for production of cryogenic targets for hot plasma experiments.** Sadowski, M.; Szydlowski, A.; Jakubowski, L.; Cwiek, E. Soltan Inst. for Nuclear Studies, Otwock-Swierk (Poland). Oct 1990. 18p. Order Number DE93608181. Source: OSTI; NTIS (US Sales Only); INIS.

Results of preliminary operational tests of the cryogenic stand designed for the production of small droplets of liquid hydrogen or deuterium are presented. Such cryogenic micro-targets are needed for nuclear and thermonuclear experiments. (author).

6613 Other Aspects of Physical Science

Refer also to citation(s) 3909, 4656

4453 (DESY–92-099) **Aspects of canonical gravity and supergravity.** Nicolai, H. (Hamburg Univ. (Germany). 2. Inst. fuer Theoretische Physik); Matschull, H.J. Deutsches Elektronen-Synchrotron (DESY), Hamburg (Germany). Jul 1992. 19p. Order Number DE93728890. Source: OSTI; NTIS (US Sales Only).

In these lectures, we review some recent developments in canonical gravity and supergravity with special emphasis on issues related to Ashtekar's variables. Their construction and the formal solutions to the quantum constraints of pure gravity in four dimensions are discussed at an introductory level. We then consider topological (N=1) and matter coupled (N=2) supergravity in three dimensions. For N=1 supergravity we derive the observables and a complete set of solutions to the quantum constraints. Finally, we work out the canonical structure of N=2 supergravity and show that there exist physical observables based on 'hidden symmetries'. The quantization of this theory is briefly discussed. (orig.).

4454 (DOE/ER/10774–11) **Very high energy gamma ray astrophysics: Technical progress report, May 1, 1990–April 30, 1991.** Lamb, R.C.; Lewis, D.A. Iowa State Univ. of Science and Technology, Ames, IA (United States). 1 Feb 1991. 17p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC02-80ER10774. Order Number DE93003657. Source: OSTI; NTIS; INIS; GPO Dep.

The Whipple Observatory High Resolution Camera will be used in a vigorous program of observations to search for new sources of very-high-energy gamma rays. In addition, a search for antimatter using the moon-earth system as an ion spectrometer will be begun. The first phase of GRANITE, the new 37-element 11-m camera, will be concluded with first light scheduled for September, 1991. The two cameras will operate in support of the Gamma Ray Observatory mission in the winter of 1991/2.

4455 (DOE/ER/40682–20) **Cosmological texture is incompatible with Planck-scale physics.** Holman, R. (California Univ., Santa Barbara, CA (United States). Inst. for Theoretical Physics); Hsu, S.D.H. Carnegie-Mellon Univ., Pittsburgh, PA (United States). Jan 1992. 6p. Sponsored by USDOE, Washington, DC (United States); National Aeronautics and Space Administration, Washington, DC (United States); National Science Foundation, Washington, DC (United States). DOE Contract FG02-91ER40682 ;AC02-76CH03000. Grant NSF-PHY-87-14654;Grant TNRLC-RGFY106;Grant NAGW-2381. (NSF-ITP–92-04;CMU-HEP–92-04;HUTP–92A010;FNAL/Pub–92/32-A). Order Number DE93002651. Source: OSTI; NTIS; INIS; GPO Dep.

Nambu-Goldstone modes are sensitive to the effects of physics at energies comparable to the scale of spontaneous symmetry breaking. We show that as a consequence of this the global texture proposal for structure formation requires rather severe assumptions about the nature of physics at the Planck scale.

4456 (IC–92/208) **Instabilities and nonstatistical behavior in globally coupled systems.** Perez, G.; Cerdeira, H.A. International Centre for Theoretical Physics, Trieste (Italy). Aug 1992. 24p. Order Number DE93608185. Source: OSTI; NTIS (US Sales Only); INIS.

The mean field in a globally coupled system of chaotic logistic maps does not obey the standard rules of statistics, even for systems of very large sizes. This indicates the existence of intrinsic instabilities in its evolution. Here these instabilities are related to the very non-smooth behavior of mean values in a single logistic map, as a function of its parameter. Problems of this kind do not affect a similar system of coupled tent maps, where good statistical

behavior has been found. We also explore the transition between these two regimes. (author). 15 refs, 9 figs.

4457 (IC–92/240) **Biharmonic pattern selection.** Wei Wang; Canessa, E. International Centre for Theoretical Physics, Trieste (Italy). Sep 1992. 21p. Order Number DE93608186. Source: OSTI; NTIS (US Sales Only); INIS.

A new model to describe fractal growth is discussed which includes effects due to long-range coupling between displacements u. The model is based on the biharmonic equation nabla^{4}u = 0 in two-dimensional isotropic defect-free media as follows from the Kuramoto-Sivashinsky equation for pattern formation -or, alternatively, from the theory of elasticity. As a difference with Laplacian and Poisson growth models, in the new model the Laplacian of u is either zero or proportional to u. Its discretization allows to reproduce a transition from dense to multibranched growth at a point in which the growth velocity exhibits a minimum similarly to what occurs within Poisson growth in planar geometry. Furthermore, in circular geometry the transition point is estimated for the simplest case from the relation r_i approx. L/e$^{1/2}$ such that the trajectories become stable at the growing surfaces in a continuous limit. Hence, within the biharmonic growth model, this transition depends only on the system size L and occurs approximately at a distance 60% far from a central seed particle. The influence of biharmonic patters on the growth probability for each lattice site is also analysed. (author). 26 refs, 5 figs.

4458 (IC–92/246) **Life and water.** Rosu, H. International Centre for Theoretical Physics, Trieste (Italy). Aug 1992. 9p. Order Number DE93608187. Source: OSTI; NTIS (US Sales Only); INIS.

Many living organisms on Earth are strongly dependent on water, the natural liquid of the planet. A possible reason for that could be the conjecture of Ryoji Takahashi that water microdrops release negenetropy through a phase transition to a phase with zero surface tension. Biological cells could make use of such a phase transition in their duty cycle. We comment on the relative merit of this conjecture, and present it in wider theoretical context. (author). 10 refs.

4459 (IC–92/259) **Spline approximation for system of n-th order nonlinear ordinary differential equations.** Abou El-Ela, M.N. (International Centre for Theoretical Physics, Trieste (Italy)); Abd El-Salam, F.A. International Centre for Theoretical Physics, Trieste (Italy). Sep 1992. 10p. Order Number DE93608188. Source: OSTI; NTIS (US Sales Only); INIS.

A spline method for approximating the solution of a system of nonlinear ordinary differential equations is presented. Errors of the method are estimated and the stability of this method is proved. 3 refs, 1 tab.

4460 (LA-UR–92-3049) **The Prospector mission.** Edwards, B. (Los Alamos National Lab., NM (United States)); Pieters, C.; Ulmer, M.; Henrikson, C. Los Alamos National Lab., NM (United States). 7 Sep 1992. 12p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. (CONF-9211107–1: Discovery program workshop, San Jaua Capistrano, CA (United States), 16 Nov 1992). Order Number DE93000656. Source: OSTI; NTIS; GPO Dep.

The Prospector mission combines high resolution visual/near-infrared(IR) imaging spectroscopy with moderately high resolution K- and L-line X-ray fluorescence mapping. These combined capabilities can be used to map the composition of virtually all solar-system objects, ranging from those that lack atmospheres (Mercury, the Earth's Moon, asteroids, and Martian satellites) to the upper atmosphere of Venus. For the purpose of mission definition and development, we have focused here on a mapping, mission to the moons of Mars-specifically Phobos, which is an easily accessible small body of the Solar System and has long been an object of intense speculation. Phobos is variously interpreted as a captured asteroid, a captured but disrupted basaltic achondrite body with anomalously low density, a comet nucleus, a body of reassembled Mars material ejected into orbit during a large impact event, a body of unknown origin but covered by an accumulation of cosmic dust and/or material ejected from Deimos, or none of the above. Multispectral observations of Phobos by instruments on the Phobos 2 spacecraft indicate that the surface of the moon is spectrally heterogeneous, with at least four units based on extended visible color. Distribution of color ratio units are most likely caused by compositional heterogeneity and surficial processes. The composition and structure of Phobos remains a stimulating scientific question, but Phobos is much more than a cipher among planetary phenomena. The low ΔV requirements for missions to Phobos make it readily accessible-much more so than the Martian surface. The low orbital height of Phobos make it an attractive platform for staging Mars observation and exploration. Furthermore, the possible chondritic nature of Phobos may provide a valuable reservoir of extractable H, C, N, 0, and S.

4461 (LA-UR–92-3079) **The dependence of pulsating auroral events on energetic electrons and cold plasma near the equatorial plane.** Nemzek, R.J. (Los Alamos National Lab., NM (United States)); Belian, R.D.; McComas, D.J.; Thomsen, M.F.; Nakamura, R.; Baker, D.N.; Yamamoto, T. Los Alamos National Lab., NM (United States). [1992]. 7p. Sponsored by USDOE, Washington, DC (United States); National Aeronautics and Space Administration, Washington, DC (United States). DOE Contract W-7405-ENG-36. (CONF-9208162–1: 19. annual European meeting on atmospheric studies by optical methods, Kiruna (Sweden), 10-14 Aug 1992). Order Number DE93000856. Source: OSTI; NTIS; GPO Dep.

Pulsating auroras are a substorm recovery phase phenomenon, occurring shortly after an auroral breakup. The current theory of the pulsating aurora involves a "relaxation oscillator" mechanism requiring a population of high-energy (10's of keV) electrons and a low-energy plasma number density on the order of a few particles per cm^3. We investigated this relationship by comparing energetic electron and plasma data from a geosynchronous satellite to pulsating auroras recorded by an all-sky video camera which contained the satellite's ionospheric conjugate point in its field of view. Pulsating auroral events were generally closely connected to substorm injections on the satellite, but there was no clear correlation with changes in plasma density. During all of the events the density was in an acceptable range for the relaxation oscillator mechanism to function. The relationship to substorm injections impiles that the pulsating aurora can be used to map the substorm injection region down to the ionosphere. An unusual diminishing of the pulsating aurora during the growth phase of a subsequent substorm was also discovered.

4462 (LA-UR–92-3132) **Milagro: A low energy threshold extensive air shower array.** Sinnis, G. CYGNUS and MILAGRO Collaborations. Los Alamos National Lab., NM (United States). [1992]. 13p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. (CONF-9206293–1: Towards a major atmospheric Cherenkov detector for TeV astro/particle physics, Palaiseau (France), 11-12 Jun 1992). Order Number DE93000852. Source: OSTI; NTIS; GPO Dep.

Milagro is a proposed extensive air shower (EAS) array with a large water Cerenkov detector at its center. It will have a low energy threshold, $\sim$ 500 GeV, and good angular resolution, $\sim$ 0.4°. With the large aperture and duty factor of an EAS array, and the energy threshold of an atmospheric Cerenkov telescope, it will be ideally poised to discover new, steady sources of very high energy gamma radiation similar to the Crab nebula, and transient phenomena analogous to the gamma ray bursts seen at lower energies. Here we describe the Milagro detector and give results of tests performed at the CYGNUS array that demonstrate the capabilities of the water Cerenkov technique in detecting and reconstructing extensive air showers.

4463 (LA-UR–92-3144) **Convection in RR Lyrae stars.** Stellingwerf, R.F. (Los Alamos National Lab., NM (United States)); Bono, G. Los Alamos National Lab., NM (United States). [1992]. 10p. Sponsored by USDOE, Washington, DC (United States); National Science Foundation, Washington, DC (United States). DOE Contract W-7405-ENG-36. (CONF-9207156–2: International Astronomical Union (IAU) colloquium 139 on new perspectives on stellar pulsation and pulsating variable stars, Victoria (Canada), 7-11 Jul 1992). Order Number DE93000851. Source: OSTI; NTIS; GPO Dep.

Convection undoubtedly plays a strong role in defining the RR Lyrae instability strip, but its effects on amplitude, mode of pulsation, and light curve have always been problematical. One reason

is simple that convective models are difficult to compute, and their accuracy is difficult to ascertain. We present results of a new convective survey of RR Lyrae stars that constitute the best models available at this time, with better boundary conditions, physics, zoning, and length of computational run than previous results.

4464 (LBL–32436) **Measurements of the cosmic microwave background temperature at 1.47 GHz.** Bensadoun, M.J. Lawrence Berkeley Lab., CA (United States). Nov 1991. 135p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC03-76SF00098. Order Number DE93000587. Source: OSTI; NTIS; GPO Dep.

A radiofrequency-gain total power radiometer measured the intensity of the cosmic microwave background (CMB) at a frequency of 1.47 GHz (20.4 cm wavelength) from White Mountain, California, in September 1988 and from the South Pole, Antarctica, in December 1989. The CMB thermodynamic temperature, TCMB, is 2.27 ± 0.25 K (68% C.L.) measured from White Mountain and 2.26 ± 0.21 K from the South Pole site. The combined result is 2.27 ± 0.19 K. The correction for galactic emission has been derived from scaled low-frequency maps and constitutes the main source, of error. The atmospheric signal is found by extrapolation from zenith scan measurements at higher frequencies. The result is consistent with previous low-frequency measurements, including a measurement at 1.41 GHz (Levin et al. 1988) made with an earlier version of this instrument. The result is ~2.5 σ (~l% probability) from the 2.74 ± 0.02,K global average CMB temperature.

4465 (LBL–32695) **Infinite-mode squeezed coherent states and non-equilibrium statistical mechanics (phase-space-picture approach).** Yeh, L. Lawrence Berkeley Lab., CA (United States). 14 Aug 1992. 14p. Sponsored by USDOE, Washington, DC (United States); National Science Foundation, Washington, DC (United States). DOE Contract AC03-76SF00098. Grant PHY-90-21139. (CONF-9205247–2: International workshop on squeezed states, Moscow (Russian Federation), 25-29 May 1992; UCB-PTH–92/25). Order Number DE93002559. Source: OSTI; NTIS; INIS; GPO Dep.

The phase-space-picture approach to quantum non-equilibrium statistical mechanics via the characteristic function of infinite- mode squeezed coherent states is introduced. We use quantum Brownian motion as an example to show how this approach provides an interesting geometrical interpretation of quantum non-equilibrium phenomena.

4466 (SAND–92-2083C) **Thermo-visco-inelasticity in large deformations.** Herrmann, W. Sandia National Labs., Albuquerque, NM (United States). 10 Sep 1992. 16p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-76DP00789. (CONF-9209240–4: Society of Engineering Science (SES) technical meeting, San Diego, CA (United States), 14-16 Sep 1992). Order Number DE93002284. Source: OSTI; NTIS; GPO Dep.

A formulation is given of constitutive equations valid for large deformations for materials with elastic range and internal state variables intended to describe the internal structure of the material. A material description is used to construct a purely mechanical theory which largely follows that of Carroll. The assumption that the work done in finite closed cycles of homogeneous deformation is nonnegative leads to an elastic potential and a dissipation inequality which, in turn, implies a normality condition, by an argument adapted from that of Lin and Naghdi. When the theory is generalized to include temperature dependence, the Clausius-Duhem inequality leads by well-known arguments to an elastic potential and nonnegative dissipation. Rate effects are included by assuming that the inelastic strain rate is a function of the dynamic overstress, but the results of the work assumption or the thermodynamic argument are unchanged. Some remarks regarding implications for stability are made.

4467 (UCRL-JC–111946) **Recent progress on astrophysical opacity.** Rogers, F.J.; Iglesias, C.A. Lawrence Livermore National Lab., CA (United States). Aug 1992. 9p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. (CONF-9208135–4: International conference on the physics of strongly coupled plasmas, Rochester, NY (United States), 17-21 Aug 1992). Order Number DE93002892. Source: OSTI; NTIS; INIS; GPO Dep.

Improvements in the calculation of the opacity of astrophysical plasmas has helped to resolve several long-standing puzzles in the modeling of variable stars. The most significant opacity enhancements over the Los Alamos Astrophysical Library (LAOL) are due to improvements in the equation of state and atomic physics. Comparison with experiment has corroborated the predicted large opacity increases due to transitions in M-shell iron. We give a summary of recent developments.

6620 Physics of Elementary Particles and Fields

Refer also to citation(s) 4578

4468 (DOE/ER/40200–298) **Research program in particle physics: Progress report, January 1, 1992–December 1992.** Sudarshan, E.C.G.; Dicus, D.A.; Ritchie, J.L.; Lang, K. Texas Univ., Austin, TX (United States). Center for Particle Theory. Jul 1992. 50p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG05-85ER40200. Order Number DE93001797. Source: OSTI; NTIS; INIS; GPO Dep.

This report discusses the following topics: Quantum Gravity and Mathematical Physics; Phenomenology; Quantum Mechanics and Quantum Field Theory; Status of BNL Expt. 791; BNL Expt. 791; BNL Expt. 888; and SSC Activities.

4469 (DOE/ER/40516–2) **The study of multi-institutional collaborations in high-energy physics: Progress report, January 1989–March 1991.** American Inst. of Physics, New York, NY (United States). Center for History of Physics. [1991]. 75p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG02-89ER40516. Order Number DE93002337. Source: OSTI; NTIS; INIS; GPO Dep.

Since World War II, the organizational framework for scientific research is increasingly the multi-institutional collaboration, especially in high-energy physics. A broad preliminary survey, into the functioning of research collaborations involving three or more institutions is described. The study is designed to identify patterns of collaborations, define the scope of the documentation problems, field-test possible solutions, recommend future actions, and build an archives of oral history interviews and other resources for scholarly use. Once the study is completed, its findings will be used to promote systems to document significant collaborative research.

4470 (DOE/ER/40651–2) **[Research programs on elementary particle and field theories and superconductivity]: Technical progress report, June 1, 1991–October 1, 1992.** Khuri, N.N. Rockefeller Univ., New York, NY (United States). [1992]. 26p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG02-91ER40651. (RU–92/16/B). Order Number DE93003147. Source: OSTI; NTIS; INIS; GPO Dep.

Research of staff members in theoretical physics is presented in the following areas: super string theory, a new approach to path integrals, new ideas on the renormalization group, nonperturbative chiral gauge theories, the standard model, K meson decays, and the CP problem. Work on high-$T_c$superconductivity and protein folding is also related.

4471 (DOE/ER/40654–2) **Harvard University High Energy Physics progress report.** Harvard Univ., Cambridge, MA (United States). High Energy Physics Lab. [1992]. 28p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG02-91ER40654. Order Number DE93002091. Source: OSTI; NTIS; INIS; GPO Dep.

The principal goals of this work are to carry out forefront programs in high energy physics research and to provide first rate educational opportunities for students. The experimental program supported through HEPL is carried out at the major accelerator centers in the world and addresses some of the most important questions in high energy physics. The program is based at Harvard's High Energy Physics Laboratory, which has offices, computing facilities, and engineering support, and both electronics and machine shops.

4472 (DOE/ER/40671–1) **High energy physics research: Technical progress report.** Piroue, P.A. Princeton Univ., NJ (United States). Oct 1992. 22p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG02-91ER40671. Order Number DE93001793. Source: OSTI; NTIS; INIS; GPO Dep.

The goal of this research is to understand the fundamental constituents of matter and their interactions. At this time, the following activities are underway: e^+e^- interactions and Z^0 physics at CERN; studies to upgrade the L3 detector at LHC; very high statistics charm physics at Fermilab; search for the H particle at BNL; search for the fifth force; rare kaon decay experiments at BNL; study of B-meson physics at hadron colliders; e^+e^- pair creation by light at SLAC; R&D related to SSC experiments and the GEM detector; and theoretical research in elementary particle physics and cosmology. The main additions to the activities described in detail in the original grant proposal are (1) an experiment at SLAC (E-144) to study strong-field QED effects in e-laser and γ-laser collisions, and (2) a search for the H particle at BNL (E-188). The R&D efforts for the GEM detector have also considerably expanded. In this paper we give a brief status report for each activity currently under way.

4473 (DOE/ER/40676–2) **Research in particle physics: Progress report, June 1, 1992–January 31, 1993.** Boston Univ., MA (United States). Dept. of Physics. Sep 1992. 167p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG02-91ER40676. Order Number DE92041135. Source: OSTI; NTIS; INIS; GPO Dep.

Research accomplishments and current activities of Boston University researchers in high energy physics are presented. Principal areas of activity include the following: detectors for studies of electron–positron annihilation in colliding beams; advanced accelerator component design, including the superconducting beam inflector, electrostatic quadrupoles, and the "electrostatic muon kicker"; the detector for the MACRO (Monopole, Astrophysics, and Cosmic Ray Observatory) experiment; neutrino astrophysics and the search for proton decay; theoretical particle physics (electroweak and flavor symmetry breaking, hadron collider phenomenology, cosmology and astrophysics, new field-theoretic models, nonperturbative investigations of quantum field theories, electroweak interactions); measurement of the anomalous magnetic moment of the muon; calorimetry for the GEM experiment; and muon detectors for the GEM experiment at the Superconducting Super Collider.

4474 (DOE/ER/40682–17) **High energy physics.** Carnegie-Mellon Univ., Pittsburgh, PA (United States). Dept. of Physics. 10 Apr 1992. 60p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG02-91ER40682. (CMU–04422). Order Number DE93002411. Source: OSTI; NTIS; INIS; GPO Dep.

The Counter Group continues to work on data analysis for Fermilab Experiment E653. Altogether, they expect several thousand reconstructed charm events and approximately 25 B pair events of which 12 have been observed thus far. Preparation continue for Fermilab Experiment E781, a high statistics study of charm baryon production. In the Theory Group, Cutkosky and collaborators study hadron phenomenology and non-perturbative QCD calculations. Levine has a long standing program in computational QED to obtain improved theoretical values for g-2 of the electron. Wolfenstein, Li, and their collaborators have worked on areas of weak interaction phenomenology that may yield insights beyond the standard model, e.g. CP violation and non-zero neutrino masses. Holman has been concerned with phase transitions in gauge theories relevant to cosmological problems. During 1991 most of the group effort was concentrated on the L3 experiment at CERN. Highlights of the results from the analysis of the Z^0 resonance include (a) a measurement of the strong coupling constant α_s for b quarks (b) a precision measurement of the average time of B hadrons and (c) a direct determination of the number of light neutrino faculties from the reaction $e^+e^- \rightarrow \nu\bar{\nu}\gamma$. We also began a major upgrade of the L3 luminosity monitor by replacing PWC chamber by a Si strip system in front of the BGO calorimeters. Finally we have continued our SSC R&D work on BaF_2 by joining the GEM collaboration.

4475 (DOE/ER/40684–1) **[High energy physics research]: Annual performance report, December 1, 1991–November 30, 1992.** Rosen, J.; Block, M.; Buchholz, D.; Gobbi, B.; Schellman, H.; Buchholz, D.; Rosen, J.; Miller, D.; Braaten, E. Chang, D.; Oakes, R.; Schellman, H. Northwestern Univ., Evanston, IL (United States). [1992]. 96p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG02-91ER40684. Order Number DE93003154. Source: OSTI; NTIS; INIS; GPO Dep.

The various segments of the Northwestern University high energy physics research program are reviewed. Work is centered around experimental studies done primarily at FNAL; associated theoretical efforts are included.

4476 (DOE/ER/40689–T1) **Santa Cruz Institute for Particle Physics (SCIPP).** Burchat, P.; Dorfan, D.; Litke, A.; Heusch, C.; Sadrozinski, H.; Schalk, T.; Seiden, A. California Univ., Santa Cruz, CA (United States). [1992]. 108p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG03-92ER40689. Order Number DE93002639. Source: OSTI; NTIS; INIS; GPO Dep.

Work for the coming year is a logical continuation of the efforts of the past year. Some special highlights of this past year which are discusses in more detail in this report are: (1) The move onto beamline and start of ZEUS data taking. (2) The completion of the SDC technical proposal including a detailed long-term plan for construction. (3) Continuing publication of very detailed physics results from ALEPH concerning τ and b physics, and a precision measurement of electroweak and QCD parameters. (4) Completion of very successful data taking for E-791 at Fermilab, with nearly twice as many events recorded as initially proposed. (5) First measurement of beam polarization at the SLC. These efforts have led to about 15 physics publications this past year centered mainly on topics related to QCD, couplings of flavors to the Z^0, and heavy flavor decays. Taken as a whole, the results in jets from LEP, the ratio of hadronic to leptonic decays of the τ the leptonic branching fraction of the J/ψ, and the charmonium mass spectrum provide a very consistent set of values of α_s at a variety of scales. In particular, they show the running of α_s by a factor of about three from m_τ to m_z. Results from LEP also provide evidence of the triple gluon vertex. Similarly, the measurement of the $b\bar{b}$ fraction of Z^0 decays, from the MARK II as well as LEP, provide increasingly better measurements of the Z^0 coupling to b quarks. Combined with earlier precision measurements of the Z^0 mass, width, and leptonic branching fractions, the Z^0 decays continue to provide a very precise verification of the Standard Model.

4477 (DOE/ER/40690–1) **Research in elementary particle physics: Annual report, January 1–October 31, 1992.** Ohio State Univ., Columbus, OH (United States). Dept. of Physics. [1992]. 81p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG02-91ER40690. Order Number DE93003153. Source: OSTI; NTIS; INIS; GPO Dep.

Experimental and theoretical work on high energy physics is reviewed. Included are preparations to study high-energy electron-proton interactions at HERA, light-cone QCD, decays of charm and beauty particles, neutrino oscillation, electron-positron interactions at CLEO II, detector development, and astrophysics and cosmology.

4478 (DOE/ER/40715–1) **[High energy physics]: Progress report, [January 1, 1992–December 31, 1992].** Massachusetts Univ., Amherst, MA (United States). [1992]. 14p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG02-92ER40715. Order Number DE93002418. Source: OSTI; NTIS; INIS; GPO Dep.

This report discusses high energy physics research being conducted at the Stanford Linear Collider using the time projection chamber and the SLD detector.

6621 General Theory of Particles and Fields

Refer also to citation(s) 4436, 4437, 4455, 4512, 4557

4479 (CBPF-NF–037/91) **An alternative prescription for Gauging Floreanini-Jackiw chiral bosons.** Dias, S.A.; Souza Dutra, A. de. Centro Brasileiro de Pesquisas Fisicas (CBPF), Rio de Janeiro, RJ (Brazil). 1991. 18p. Order Number DE93608243. Source: OSTI; NTIS (US Sales Only); INIS.

We seek new couplings of chiral bosons to U (1) gauge fields. Lorentz covariance of the resulting constrained Lagrangian is checked with the help of a procedure based in the first-order formalism of Faddeev and Jackiw. We find Harada's constraint and another local one not previously considered, besides infinite nonlocal couplings.We analyze the constraint structure and part of the spectrum of this second solution and show that it is equivalent to an explicitly covariant coupling of Siegel's chiral boson to gauge fields, which preserves chirality under gauge transformations. (author).

4480 (DESY–92-018) **Lagrangians and anomaly-candidates of D=4, N=1 rigid supersymmetry.** Brandt, F. (Hannover Univ. (Germany). Inst. fuer Theoretische Physik). Deutsches Elektronen-Synchrotron (DESY), Hamburg (Germany). Jun 1992. 36p. (ITP-UH–3/92). Order Number DE93728832. Source: OSTI; NTIS (US Sales Only); INIS.

It is investigated how to construct the most general invariant action and whether there are anomaly-candidates is D=4, N=1 globally supersymmetric theories. The importance of the representation theory of the supersymmetry algebra for these questions is discussed. For a class of theories with special sypersymmetric multiplet structure complete answers are given. Examples of more general cases are discussed. (orig.).

4481 (DESY–92-067) **Local couplings, double insertions and the Weyl consistency condition.** Kraus, E. (Deutsches Elektronen-Synchrotron (DESY), Hamburg (Germany)); Sibold, K. Deutsches Elektronen-Synchrotron (DESY), Hamburg (Germany). May 1992. 33p. Order Number DE93728758. Source: OSTI; NTIS (US Sales Only); INIS.

Within massless $\phi^4{}_4$-theory we set up the formalism which is needed, when the coupling λ is permitted to become an external field, i.e. a function of space-time. In particular we have worked out the action of the corresponding Callan-Symanzik operator and conformal transformations on the vertex functions, and furthermore how the Weyl transformations act on the theory with the energy-momentum tensor invariantly coupled. With the help of the Weyl consistency condition we have shown that in the limit of constant coupling the Weyl braking can entirely be written in terms of differential operators, but that otherwise, for truely local coupling, new breaking terms survive. (orig.).

4482 (DESY–92-068) **Quasi quantum group covariant q-oscillators.** Schomerus, V. (Hamburg Univ. (Germany). 2. Inst. fuer Theoretische Physik). Deutsches Elektronen-Synchrotron (DESY), Hamburg (Germany). May 1992. 22p. Order Number DE93728757. Source: OSTI; NTIS (US Sales Only); INIS.

If q is a p-th root of unity there exists a quasi-co-associative truncated quantum group algebra $U^T{}_q\,(sl_2)$ whose indecomposable representations are the physical representations of $U_q(sl_2)$, whose co-product yields the truneated tensor product of physical representations of $U_q(sl_2)$, and whose R-matrix satisfies quasi Yang Baxter equations. For primitive p-th roots q, we consider a 2-dimensional q-oscillator which admits $U^T{}_q(sl_2)$ as a symmetry algebra. Its wave functions lie in a space $F^T{}_q$ of 'functions on the truncated quantum plane', i.e. of polynomials in noncommuting complex coordinate functions z_a, on which multiplication operators Z_a and the elements of $U^T{}_q(sl_2)$ can act. This illustrates the concept of quasi quantum planes. Due to the truncation, the Hilbert space of states is finite dimensional. The subspaces $F^{T(n)}$ of monomials in x_a of n-th degree vanish for $n \geq$ p-1, and $F^{T(n)}$ carries the 2J+1 dimensional irreducible representation of $U^T{}_q(sl_2)$ if n=2J, J=0, 1/2, ... 1/2(p-2). Partial derivatives δ_a are introduced. We find a *-operation on the algebra of multiplication operators Z_i and derivatives δ_b such that the adjoints $Z^*{}_a$ act as differentiation on the truncated quantum plane. Multiplication operators Z_a ('creation operators') and their adjoints ('annihilation operators') obey $q^{-1/2}$-commutation relations. The *-operation is used to determine a positive definite scalar product on the truncated quantum plane $F^T{}_q$. Some natural candidates of Hamiltonians for the q-oscillators are determined. (orig./HSI).

4483 (DESY–92-072) **Dynamical symmetry as a tool to understanding properties of supersymmetric partner potentials. Example of so(2,1) symmetry.** Wehrhahn, R.F. (Hamburg Univ. (Germany). Theoretical Nuclear Physics); Cooper, I.L. Deutsches Elektronen-Synchrotron (DESY), Hamburg (Germany). May 1992. 16p. Order Number DE93728754. Source: OSTI; NTIS (US Sales Only); INIS.

Analysis of the dynamical symmetry of a system is used to predict properties arising from its supersymmetric quantum mechanical treatment. Two applications of the so(2,1) algebra, the Coulomb potential and Morse oscillator potential which display different structure with respect to the dynamical symmetry, are studied. This difference is shown to be responsible for the behaviour of the respective supersymmetric partner potentials. (orig.).

4484 (DESY–92-094) **Kinematics of multigrid Monte Carlo.** Grabenstein, M. (Hamburg Univ. (Germany). 2. Inst. fuer Theoretische Physik); Pinn, K. Deutsches Elektronen-Synchrotron (DESY), Hamburg (Germany). Jul 1992. 36p. Order Number DE93728896. Source: OSTI; NTIS (US Sales Only); INIS.

We study the kinematics of multigrid Monte Carlo algorithms by means of acceptance rates for nonlocal Metropolis update proposals. An approximation formula for acceptance rates is derived. We present a comparison of different coarse-to-fine interpolation schemes in free field theory, where the formula is exact. The predictions of the approximation formula for several interacting models are well confirmed by Monte Carlo simulations. The following rule is found: For a critical model with fundametal Hamiltonian $H(\phi)$, absence of critical slowing down can only be expected if the expansion of $(H(\phi+\psi))$ in terms of the shift ψ contains no relevant (mass) term. We also introduce a multigrid update procedure for nonabelian lattice gauge theory and study the acceptance rates for gauge group SU(2) in four dimensions. (orig.).

4485 (DESY–92-105) **The spectrum of the conserved charges in affine Toda theories.** Niedermaier, M.R. (Hamburg Univ. (Germany). 2. Inst. fuer Theoretische Physik). Deutsches Elektronen-Synchrotron (DESY), Hamburg (Germany). Jul 1992. 43p. Order Number DE93729018. Source: OSTI; NTIS (US Sales Only); INIS.

A vertex operator construction for the phase of the minimal form factor is used to predict the exact spectrum of the infinite set of conserved charges on the multi-particle states in affine Toda theories from the bootstrap S-matrix. Conversely, the scattering phase can be recovered from the spectral information. The result is checed against the classical spectrum which is calculated ab-initio using the τ-function formalism. The latter is shown to provide a considerable shortcut compared to the traditional use of the inverse scattering transform. (orig.).

4486 (DESY–92-111) **Numerical simulation of heavy fermions in an $SU(2)_L x SU(2)_R$ symmetric Yukawa model.** Frick, C. (RWTH Aachen (Germany). Inst. fuer Theoretische Physik E); Trappenberg, T.; Lin, L.; Muenster, G.; Plagge, M.; Montvay, I.; Wittig, H. Deutsches Elektronen-Synchrotron (DESY), Hamburg (Germany). Jul 1992. 28p. Order Number DE93728876. Source: OSTI; NTIS (US Sales Only); INIS.

An exploratory numerical study of the influence of heavy fermion doublets on the mass of the Higgs boson is performed in the decoupling limit of a chiral $SU(2)_L$ x $SU(2)_R$ symmetric Yukawa model with mirror fermions. The behaviour of fermion and boson masses is investigated at infinite bare quartic coupling on 4^3 x 8, 6^3 x 12 and 8^3 x 16 lattices. A first estimate of the upper bound on the renormalized quartic coupling as a function of the renormalized Yukawa-coupling is given. (orig.).

4487 (DOE/ER/40542–73) **Problems in particle theory: Technical report 1991–1992.** Adler, S.L.; Wilczek, F. Institute for Advanced Study, Princeton, NJ (United States). Nov 1992. 19p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG02-90ER40542. Order Number DE93003687. Source: OSTI; NTIS; INIS; GPO Dep.

Members of the Institute have worked on a number of problems including the following: acceleration algorithms for the Monte Carlo analysis of lattice field, and gauge and spin theories, based on changes of variables specific to lattices of dimension 2^d; construction of quaternionic generalizations of complex quantum mechanics and field theory; wave functions for paired Hall states; black hole quantum mechanics; generalized target-space duality in curved string backgrounds; gauge symnmetry algebra of the N = 2 string; two-dimensional quantum gravity and associated string theories;

organizing principles from which the signal processing of neural networks in the retina and cortex can be deduced; integrable systems of KdV type; and a theory for Kondo insulators.

4488 (DOE/ER/40682–10) **Baryon asymmetry from Planck-scale physics.** Gelmini, G. (California Univ., Los Angeles, CA (United States). Dept. of Physics); Holman, R. Carnegie-Mellon Univ., Pittsburgh, PA (United States). Jun 1992. 6p. Sponsored by USDOE, Washington, DC (United States); National Science Foundation, Washington, DC (United States). DOE Contract FG02-91ER40682 ;AC02-76ER03066. Grant PHY89-04035. (CMU-HEP–92-15;NSF-ITP–92-101;UCLA–92/TEP/25). Order Number DE93002643. Source: OSTI; NTIS; INIS; GPO Dep.

It has been noted recently that Planck scale physics may induce the explicit breaking of global symmetries. We point out that in Majoron models, these explicit breakings, combined with sphaleron induced violation of B + L can give rise to the baryon asymmetry of the Universe.

4489 (DOE/ER/40682–19) **Solutions to the strong-CP problem in a world with gravity.** Holman, R. (California Univ., Santa Barbara, CA (United States). Inst. for Theoretical Physics); Hsu, S.D.H.; Kephart, T.W. Carnegie-Mellon Univ., Pittsburgh, PA (United States). Jan 1992. 6p. Sponsored by USDOE, Washington, DC (United States); National Aeronautics and Space Administration, Washington, DC (United States); National Science Foundation, Washington, DC (United States); Texas State Government, Austin, TX (United States); Harvard Uni DOE Contract FG02-91ER40682 ;AC02-76ER03066 ;FG05-85ER40226. Grant PHY89-04035;Grant NSF-PHY-87-14654;Grant TNRLC-RGFY106;Gra (NSF-ITP–92-06;CMU-HEP–92-05;HUTP–92A011;FNAL/Pub–92/34-A). Order Number DE93002650. Source: OSTI; NTIS; INIS; GPO Dep.

We examine various solutions of the strong-CP problem to determine their sensitivity to possible violations of global symmetries by Plauck scale physics. While some solutions remain viable even in the face of such effects. Violations of the Peccei-Quinn (PQ) symmetry by non-renormalizable operators of dimension less than 10 will generally shift the value of $\bar{\theta}$ to values inconsistent with the experimental bound $\bar{\theta} \lesssim 10^{-9}$. We show that it is possible to construct axion models where gauge symmetries protect PQ symmetry to the requisite level.

4490 (DOE/ER/40716–1) **[Investigations in particle and field theory]: Progress report, September 1992.** Connecticut Univ., Storrs, CT (United States). [1992]. 5p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG02-92ER40716. Order Number DE93002163. Source: OSTI; NTIS; INIS; GPO Dep.

This report discusses quantum chromodynamics in axial gauges, gauge theories in 2+1 dimensions, non-perturbative structure of the nucleon, and fourth order conformal Weyl invariant theory of gravity.

4491 (GSI–92-55(prepr.)) **The equal-time Wigner transform of the Klein-Gordon field and pair creation.** Best, C. (Tel Aviv Univ. (Israel). School of Physics and Astronomy); Eisenberg, J.M.; Greiner, W.; Soff, G. Gesellschaft fuer Schwerionenforschung mbH, Darmstadt (Germany). Aug 1992. 7p. Order Number DE93729008. Source: OSTI; NTIS (US Sales Only); INIS.

We derive the equation that governs the Wigner function of spinless bosons in a classical electromagnetic field. It describes a relativistic gas of positively and negatively charged particles with quantum corrections due to interferences that cause pair creation. in homogeneous fields, the Schwinger term is recovered. (orig.).

4492 (IC–92/150) **BRST cohomology ring in 2D gravity coupled to minimal models.** Kanno, H.; Sarmadi, M.H. International Centre for Theoretical Physics, Trieste (Italy). Aug 1992. 20p. Order Number DE93608192. Source: OSTI; NTIS (US Sales Only); INIS.

The ring structure of Lian-Zuckerman states for (q,p) minimal models coupled to gravity is shown to be $R=R_0xC[w,w^{-1}]$ where R_0 is the ring of ghost number zero operators generated by two elements and w is an operator of ghost number -1. Some examples are discussed in detail. For these models the currents are also discussed and their algebra is shown to contain the Virasoro algebra. (author). 21 refs.

4493 (IC–92/181) **WA-circumflex(n - 1 modul n - 1)$^{(1)}$ Miura transformation: Analysis and applications.** Saidi, E.H. International Centre for Theoretical Physics, Trieste (Italy). Jul 1992. 46p. Order Number DE93608193. Source: OSTI; NTIS (US Sales Only); INIS.

We introduce the concept of conformal spin gradation of the untwisted affine Lie superalgebra A-circumflex(n -1 modul n - 1)$^{(1)}$ to study the WA-circumflex(n - 1 modul n - 1)$^{(1)}$ Miura transformation. We show that the essential of A-circumflex(n - 1 modul n - 1)$^{(1)}$ may be read from the conformal spin gradation of the canonical vector basis of the SL(n modul n) vector representation space V_{2n} and a spectral parameter μ. We give the generic formula of their conformal spin weights. Then, we set up the fundamentals of a manifestly N = 2 U(1) Lax formalism leading to a manifestly N = 2 WA-circumflex(n - 1 modul n - 1)$^{(1)}$ Miura transformation. Its explicit form is obtained and is shown to have a similar structure as in the N = 0 case. Both N = 0 WA-circumflex(n - 1)$^{(1)}$ and N = 2 WA-circumflex(n - 1 modul n - 1)$^{(1)}$ Miura transformations involve (n - 1) N = 0 and N = 2 conserved currents with integer conformal spins. The leading cases are discussed. Using the U(1) charge of the N = 2 algebra, we develop also a new method of constructing N = 2 superfield realizations of the N = 2 higher spin supercurrents. Among other results, we find that in general there are three series of (n - 1) higher conformal spin N = 2 supercurrents. The usual N = 2 super W currents are the only hermitian ones. At the n = 3 level, we find a new Feigin Fuchs type extension of the conformal spin one N = 2 supercurrent. Such a feature, which has no analogue at the n = 2 level, is also present for n>3. Finally, we give the N = 2 superfield formulation of the N = 2 Boussinesq equation and its generalization involving complex N = 2 supercurrents. (author). 27 refs.

4494 (IC–92/203) **On the scalar curvature of self-dual manifolds.** Kim, J. International Centre for Theoretical Physics, Trieste (Italy). Aug 1992. 31p. Order Number DE93608194. Source: OSTI; NTIS (US Sales Only); INIS.

We generalize LeBrun's explicit "hyperbolic ansatz" construction of self-dual metrics on connected sums of conformally flat manifolds and CP^2's through a systematic use of the theory of hyperbolic geometry and Kleinian groups. (This construction produces, for example, all self-dual manifolds with semi-free S^1-action and with either nonnegative scalar curvature or positive-definite intersection form.) We then point out a simple criterion for determining the sign of the scalar curvature of these conformal metrics. Exploiting this, we then show that the sign of the scalar curvature can change on connected components of the moduli space of self-dual metrics, thereby answering a question raised by King and Kotschick. (author). Refs.

4495 (IC–92/210) **Radiation reaction for the classical relativistic spinning particle in scalar, tensor and linearized gravitational fields.** Barut, A.O.; Cruz, M.G. International Centre for Theoretical Physics, Trieste (Italy). Aug 1992. 10p. Order Number DE93608191. Source: OSTI; NTIS (US Sales Only); INIS.

We use the method of analytic continuation of the equation of motion including the self-fields to evaluate the radiation reaction for a classical relativistic spinning point particle in interaction with scalar, tensor and linearized gravitational fields in flat spacetime. In the limit these equations reduce to those of spinless particles. We also show the renormalizability of these theories. (author). 10 refs.

4496 (IC–92/212) **Distribution function of excitations in systems with fractional statistics.** Protogenov, A.P. International Centre for Theoretical Physics, Trieste (Italy). Aug 1992. 8p. Order Number DE93608195. Source: OSTI; NTIS (US Sales Only); INIS.

The distribution function of low-energy excitations in 2+1D systems has been considered. It is shown that in these systems the quantum distribution function differs from the usual one by having a finite value of the entropy of linked braids. (author). 47 refs.

4497 (IC–92/220) **A version of superstring with four space-time dimensions.** Dao Vong Duc (Institute of Theoretical

Physics, Hanoi (Viet Nam)); Nguyen Hong Ha; Nguyen Lan Oanh. International Centre for Theoretical Physics, Trieste (Italy). Aug 1992. 5p. Order Number DE93608196. Source: OSTI; NTIS (US Sales Only); INIS.

We consider a version of reducing the critical dimension of space-time for superstrings based on the internal symmetry group O(p,q). The new additional oscillators used are antisymmetric second rank tensors associated with this group. The model admits the solution without extra spatial dimension. (author). 9 refs.

4498 (IC–92/226) **The Lax operator approach for the Virasoro and the W-constraints in the generalized KdV hierarchy.** Panda, S.; Roy, S. International Centre for Theoretical Physics, Trieste (Italy). Aug 1992. 26p. Order Number DE93608197. Source: OSTI; NTIS (US Sales Only); INIS.

We show directly in the Lax operator approach how the Virasoro and W-constraints on the τ-function arise in the p-reduced KP hierarchy or Generalized KdV hierarchy. In particular, we consider the KdV and the Boussinesq hierarchy to show that the Virasoro and the W-constraints follow from the string equation by expanding the "additional symmetry" operator in terms of the Lax operator. We also mention how this method could be generalized for higher KdV hierarchies. (author). 34 refs.

4499 (IC–92/238) **Renormalization of Yang-Mills theory in the light-cone gauge using Lagrange-multiplier field.** Mansur Chowdhury, M.A. International Centre for Theoretical Physics, Trieste (Italy). Aug 1992. 9p. Order Number DE93608198. Source: OSTI; NTIS (US Sales Only); INIS.

It is well established that the Yang-Mills theory is renormalizable in covariant gauges, but there are problems in non covariant gauges, specially in the light-cone gauge. In this paper we have shown that the Yang-Mills theory is renormalizable in the light-cone gauge. Using covariant background field quantization with Lagrange-multiplier field the one-loop vacuum polarization tensor was evaluated in the light-cone planar gauge. We found that the vacuum polarization tensor is transverse and gauge independent. (author). 13 refs, 2 figs.

4500 (IC–92/241) **A note on the Dirac canonical quantization of massive Yang-Mills theory.** Cabo Montes de Oca, A. International Centre for Theoretical Physics, Trieste (Italy). Sep 1992. 6p. Order Number DE93608199. Source: OSTI; NTIS (US Sales Only); INIS.

Various implications of the Lorentz constraint are investigated within the Dirac-brackets quantization of massive Yang-Mills theory. If follows that matrix elements of arbitrary products of the divergence operators $\delta_\mu A^a{}_\mu$ between physical states should vanish. Then, after adding certain functionals to the Hamiltonian, the effect on the physical states of the evolution operator remains unaltered. Arguments are put forward for modified expressions for the formal path integral representation of the evolution operator. (author). 11 refs.

4501 (IC–92/248) **The constraint for the lowest Landau level and the effective field theory approach for the fractional quantum hall system.** Ma Zhongshui (Academia Sinica, Beijing, BJ (China). Inst. of Theoretical Physics); Su Zhaobin. International Centre for Theoretical Physics, Trieste (Italy). Sep 1992. 13p. Order Number DE93608200. Source: OSTI; NTIS (US Sales Only); INIS.

By applying the Dirac quantization method, we build the constraint that all electrons are in the lowest Landau level into the Chern-Simons field theory approach for the fractional quantum Hall system and show that the constraint can be transmuted from hierarchy to hierarchy. For a finite system, we derive that the action for each hierarchy can be split into two parts: a surface part provides the action for the edge excitations while the remaining part is precisely the bulk action for the next hierarchy. An the action for the edge could be decoupled from the bulk only at the hierarchy filling. (author). 16 refs.

4502 (IFT-P–012/92) **The Lipkin model second order phase transition in the deformed S U(2) algebra description.** Galetti, D.; Pimentel, B.M. Instituto de Fisica Teorica (IFT), Sao Paulo, SP (Brazil). Apr 1992. 14p. Order Number DE93608201. Source: OSTI; NTIS (US Sales Only); INIS.

The standard Lipkin model is studied in the context of the su(2) deformed algebra and a new spectrum is obtained with which a new energy gap curve is calculated. A suppression of the second order phase transition originally present is observed for the deformed case. (author).

4503 (IFT-P–045/91) **Supersymmetric construction of W-algebras from super Toda and WZNW theories.** Ferreira, L.A.; Gomes, J.F.; Ricotta, R.M.; Zimerman, A.H. Instituto de Fisica Teorica (IFT), Sao Paulo, SP (Brazil). Dec 1991. 26p. Order Number DE93608244. Source: OSTI; NTIS (US Sales Only); INIS.

A systematic construction of super W-algebras in terms of the WZNW model based on a super Lie algebra is presented. These are shown to be the symmetry structure of the super Toda models, which can be obtained from the WZNW theory by Hamiltonian reduction. A classification, according to the conformal spin defined by an improved energy-momentum tensor, is discussed in general terms for all super Lie algebras whose simple roots are fermionic. A detailed discussion employing the Dirac bracket structure and an explicit construction of W-algebras for the cases of OSP (1,2), OSP (2,2), OSP (3,2) and D (2,1/α) are given. The N=1 and N=2 super conformal algebras are discussed in the pertinent cases. (author).

4504 (INIS-BR–3033) **On the geometrization of electromagnetism by torsion.** Fonseca Neto, J.B. da. Centro Brasileiro de Pesquisas Fisicas (CBPF), Rio de Janeiro, RJ (Brazil). 1984 147p. (In Portuguese). Order Number DE93608202. Source: OSTI; NTIS (US Sales Only); INIS.

The possibility of electromagnetism geometrization using an four dimension Cartan geometry is investigated. The Lagrangian density which presents dual invariance for dyons electrodynamics formulated in term of two potentials is constructed. This theory by association of two potentials with track and with torsion pseudotrack and of the field with torsion covariant divergent is described. The minimum coupling of particle gravitational field of scalar and spinorial fields with dyon geometry theory by the minimum coupling of these fields with Cartan geometry was obtained. (author).

4505 (INIS-BR–3046) **Restoration of symmetry by temperature effect under influence of external electro magnetic field in gauge theory.** Aquino, V.M. de. Sao Paulo Univ., SP (Brazil). Inst. de Fisica. 1987 102p. (In Portuguese). Order Number DE93608245. Source: OSTI; NTIS (US Sales Only); INIS.

We have analysed, within a semi classical approach, the influence of external electromagnetic field on phase transitions in gauge theories. The critical temperature was calculated for an Abelian case, scalar electrodynamics, and for an non Abelian case, the Weinberg Salam model. (author).

4506 (ITF–91-72) **Non-standard representations of the space-time groups and their applications to the dynamical theory of elementary particles.** Sannikov, S.S. AN Ukrainskoj SSR, Kiev (Ukraine). Inst. Teoreticheskoj Fiziki. 1991. 29p. (In Russian). Order Number DE93608203. Source: OSTI; NTIS (US Sales Only); INIS.

A new dynamical approach to the elementary particles problem is proposed. Mathematical foundations of such an approach (non-unitary quantum theory) are developed. Investigation of the structure of the space-time and Dirac vibration in the region of very small distances forms the basis of our considerations. 10 refs. (author).

4507 (ITP–91-29) **1/N-correction to process of dynamical chiral-symmetry breaking in (2+1)-dimensional QED.** Kotikov, A.V. AN Ukrainskoj SSR, Kiev (Ukraine). Inst. Teoreticheskoj Fiziki. 1991. 5p. Order Number DE93608204. Source: OSTI; NTIS (US Sales Only); INIS.

QED in (2+1) dimensions is analyzed in both the leading and the next-to-leading orders in the 1/N expansions. 7 refs. (author).

4508 (LA-UR–92-3073) **Pair production and back reaction in strong fields: Numerical results.** Mottola, E. Los Alamos National Lab., NM (United States). [1992]. 18p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. (CONF-9205258–1: QUARKS '92, Zvenigorod (Russian Federation), 11-16 May 1992). Order Number DE93000859. Source: OSTI; NTIS; INIS; GPO Dep.

The problem I shall address in detail in this talk is pair production of either bosons or fermions from strong electric fields which are functions only of time t, or only of the fluid proper time $\tau = (t^2 - z^2)^{1/2}$. I shall compare the results of the numerical simulation of this problem (for the degradation of the field, the particle spectra, etc.) with a semi-classical transport approach using a Schwinger-inspired source term.

4509 (SLAC–406) **Dressed skeleton expansion and the coupling scale ambiguity problem.** Lu, Hung Jung. Stanford Linear Accelerator Center, Menlo Park, CA (United States). Sep 1992. 126p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC03-76SF00515. Order Number DE93002516. Source: OSTI; NTIS; INIS; GPO Dep.

Perturbative expansions in quantum field theories are usually expressed in powers of a coupling constant. In principle, the infinite sum of the expansion series is independent of the renormalization scale of the coupling constant. In practice, there is a remnant dependence of the truncated series on the renormalization scale. This scale ambiguity can severely restrict the predictive power of theoretical calculations. The dressed skeleton expansion is developed as a calculational method which avoids the coupling scale ambiguity problem. In this method, physical quantities are expressed as functional expansions in terms of a coupling vertex function. The arguments of the vertex function are given by the physical momenta of each process. These physical momenta effectively replace the unspecified renormalization scale and eliminate the ambiguity problem. This method is applied to various field theoretical models and its main features and limitations are explored. For quantum chromodynamics, an expression for the running coupling constant of the three-gluon vertex is obtained. The effective coupling scale of this vertex is shown to be essentially given by $\mu^2 \sim Q_{min}^2 Q_{med}^2 / Q_{max}^2$ where $Q_{min}^2 Q_{med}^2 / Q_{max}^2$ are respectively the smallest, the next-to-smallest and the largest scale among the three gluon virtualities. This functional form suggests that the three-gluon vertex becomes non-perturbative at asymmetric momentum configurations. Implications for four-jet physics is discussed.

6622 Specific Theories and Interaction Models; Particle Systematics

Refer also to citation(s) 4527, 4550, 4562, 4625, 4626

4510 (DESY–92-100) **On the spectral densities of hot gluons.** Schulz, H. (Hannover Univ. (Germany). Inst. fuer Theoretische Physik). Deutsches Elektronen-Synchrotron (DESY), Hamburg (Germany). Jun 1992. 12p. (ITP-UH–5/92). Order Number DE93728891. Source: OSTI; NTIS (US Sales Only); INIS.

The first moments of the spectral densities of the resummed thermal gluon propagator are shown to have the same values as in the full interacting theory. The sum rules of the latter are derived from the equal-time commutator within the class of covariant gauges. (orig.).

4511 (DESY–92-110) **Hadronization of quark flavour dynamics including three-quark forces.** Ebert, D. (Humboldt-Univ., Berlin (Germany). Fachbereich Physik); Kaschluhn, L. Deutsches Elektronen-Synchrotron (DESY), Zeuthen (Germany). Inst. fuer Hochenergiephysik. Jul 1992. 18p. Order Number DE93728874. Source: OSTI; NTIS (US Sales Only); INIS.

We investigate an effective chiral quark model containing besides a two quark Nambu-Jona-Lasinio force also three-quark forces. By means of path-integral techniques this model is, at first, converted into a quark-diquark-meson-baryon theory and afterwards hadronized into a meson-baryon theory. This way, we have demonstrated the step-by step reduction of a three-body problem to a two-body problem in the collective field approach. (orig.).

4512 (DOE/ER/40682–15) **Metastable cosmic strings in realistic models.** Holman, R. (Carnegie-Mellon Univ., Pittsburgh, PA (United States). Dept. of Physics); Hsu, S.; Vachaspati, T.; Watkins, R. Carnegie-Mellon Univ., Pittsburgh, PA (United States). [1992]. 25p. Sponsored by USDOE, Washington, DC (United States); National Aeronautics and Space Administration, Washington, DC (United States); National Science Foundation, Washington, DC (United States); Texas State Government, Austin, TX (United States); Harvard Uni DOE Contract FG02-91ER40682. Grant PHY89-04035;Grant TNRLC-RGFY106;Grant NSF-PHY-87-14654;Gra (FERMILAB-PUB–92/228-A;HUTP–92/A032;CMU-HEP–92-20). Order Number DE93002647. Source: OSTI; NTIS; INIS; GPO Dep.

The stability of the electroweak Z-string is investigated at high temperatures. The results show that, while finite temperature corrections can improve the stability of the Z-string, their effect is not strong enough to stabilize the Z-string in the standard electroweak model. Consequently, the Z-string will be unstable even under the conditions present during the electroweak phase transition. Phenomenologically viable models based on the gauge group $SU(2)_L \times SU(2)_R \times U(1)_{B-L}$ are then considered, and it is shown that metastable strings exist and are stable to small perturbations for a large region of the parameter space for these models. It is also shown that these strings are superconducting with bosonic charge carriers. The string superconductivity may be able to stabilize segments and loops against dynamical contraction. Possible implications of these strings for cosmology are discussed.

4513 (DOE/ER/40682–16) **Bounds on the mixing of the down-type quarks with vector-like singlet quarks.** Lavoura, L.; Silva, J.P. Carnegie-Mellon Univ., Pittsburgh, PA (United States). Dept. of Physics. 8 Sep 1992. 20p. Sponsored by USDOE, Washington, DC (United States); Government of Portugal, Lisbon (Portugal). DOE Contract FG02-91ER40682. Grant BIC Nsup O C/14/91. (CMU-HEP–92-21). Order Number DE93002648. Source: OSTI; NTIS; INIS; GPO Dep.

We derive bounds on the mixing of the standard charge -1/3 quarks with vector-like isosinglet quarks, as they exist in some extensions of the standard model. We make no assumptions about the unitarity or any other features of the mixing matrix. We find that the mixing is quite constrained: we are able to set bounds on all the extra parameters which arise in the mixing matrix (CKM matrix), except on two phases. The assumption that there exists only one exotic quark leads to some extra relationships among the parameters of the mixing matrix.

4514 (IC–92/202) **Qualitative picture of mesons in the Dirac oscillator theory.** Gonzalez, A. (International Centre for Theoretical Physics, Trieste (Italy)); Loyola, G.; Moshinsky, M. International Centre for Theoretical Physics, Trieste (Italy). Aug 1992. 13p. Order Number DE93608298. Source: OSTI; NTIS (US Sales Only); INIS.

A relativistic two-particle radial equation describing a particle-antiparticle system with a Dirac oscillator interaction is written and solved by means of the 1/N expansion. The emerging picture of Dirac-oscillator mesons seems to be in qualitative agreement with meson phenomenology. The spectrum of excitation energies, the strong interaction radii, and the decay widths of states in our model are calculated and compared with the corresponding experimental magnitudes for mesons with a pure quark composition and total momentum J=L. (author). 15 refs, 3 figs.

4515 (IC–92/213) **Lepton-quark families, cosmic strings and "democratic" mass matrix.** Koca, M. International Centre for Theoretical Physics, Trieste (Italy). Aug 1992. 7p. Order Number DE93608263. Source: OSTI; NTIS (US Sales Only); INIS.

We propose a model where $SU(2)_L x SU(2)_R x U(1)$ electroweak symmetry is spontaneously broken to $SU(2)_L x U(1)_Y x T', T'$ being the binary tetrahedral group of order 24. Irreducible representations of T' consisting of three doublets and three singlets are used to distinguish the family structure. Cosmic strings, formed by the symmetry breaking mechanism, distinguish the family members above the usual electroweak scale. Natural correspondence of the irreducible representations of T' with the modes of the Dynkin diagram of E-circumflex$_6$ induces an S_3 symmetry on the Yukawa couplings leading to "democratic" mass matrix. For no room is left for the fundamental Higgs $\phi(2,2)$ a dynamical symmetry breaking via t-bar t and b-bar b condensates is invoked. (author). 14 refs, 1 fig.

4516 (IC–92/216) **17 keV neutrino and large magnetic moment solution of the solar neutrino puzzle.** Akhmedov, E.Kh.

(International Centre for Theoretical Physics, Trieste (Italy)); Senjanovic, G.; Tao Zhijian; Berezhiani, Z.G. International Centre for Theoretical Physics, Trieste (Italy). Aug 1992. 11p. (SISSA–141/92/EP;LMU–10/92.). Order Number DE93608264. Source: OSTI; NTIS (US Sales Only); INIS.

Zee-type models with Majorons naturally incorporate the 17 keV neutrino but in their minimal version fail to simultaneously solve the solar neutrino puzzle. If there is a sterile neutrino state, we find a particularly simple solution to the solar neutrino problem, which besides ν_{17} predicts a light Zeldovich-Konopinski-Mahmoud neutrino $\nu_{light}=\nu_e+\nu_\mu{}^c$ with a magnetic moment being easily as large as $10^{-11}\mu_B$ through the Barr-Freire-Zee mechanism. (author). 30 refs, 2 figs.

4517 (IFT-P–011/92) **Qed$_3$ radiative corrections in the Heisenberg picture.** Pimentel, B.M.; Suzuki, A.T.; Tomazelli, J.L. Instituto de Fisica Teorica (IFT), Sao Paulo, SP (Brazil). Apr 1992. 12p. Order Number DE93608282. Source: OSTI; NTIS (US Sales Only); INIS.

We evaluated the vacuum polarization tensor for three-dimensional quantum electrodynamics (QED_3) via Heisenberg equations of motion. We thus conclude that the photon acquires mass when such contribution is taken into account for the photon propagator. (author).

4518 (IFT-P–013/92) **Null-plane approach to the neutron pion decay and transition form-factor.** Frederico, T. (Centro Tecnico Aeroespacial (CTA-IEAv), Sao Jose dos Campos, SP (Brazil). Inst. de Estudos Avancados); Tomio, L. Instituto de Fisica Teorica (IFT), Sao Paulo, SP (Brazil). May 1992. 17p. Order Number DE93608265. Source: OSTI; NTIS (US Sales Only); INIS.

We study the $\pi^0 \rightarrow \gamma^* \gamma$ process using different model wavefunctions in the null-plane. We compute the π^0 decay and electromagnetic transition form-factor, and we found out that the π^0 width has a strong model sensitivity and should be used as an important constraint to the model wave function. (author).

4519 (INP–1504/PH) **Simulation of the space-time evolution of color-flux tubes (guidelines to the TERMITE program).** Dyrek, A. (Uniwersytet Jagiellonski, Cracow (Poland). Inst. Fizyki); Florkowski, W. Institute of Nuclear Physics, Cracow (Poland). Aug 1990. 48p. Grants CPBP 01.03 and 01.09. Order Number DE93608299. Source: OSTI; NTIS (US Sales Only); INIS.

In TURBO PASCAL for IBM PC.

We give the description of the computer program which simulates boost-invariant evolution of color-flux tubes in high-energy processes. The program provides a graphic demonstration of space-time trajectories of created particles and can also be used as Monte-Carlo generator of events. (author).

4520 (INP–1518/PH) **About chiral models of dense matter and its magnetic properties.** Kutschera, M. Institute of Nuclear Physics, Cracow (Poland). Dec 1990. 152p. (In Polish). Order Number DE93608286. Source: OSTI; NTIS (US Sales Only); INIS.

In this report the other author's papers are enclosed.

The chiral models of dense nucleon matter are discussed. The quark matter with broken chiral symmetry is described. The magnetic properties of dense matter are presented and conclusions are given. 37 refs. (A.S.).

4521 (ITP–91-39) **Effective reduced action for gauge theories at finite temperatures.** Borisenko, O.A.; Petrov, V.K. AN Ukrainskoj SSR, Kiev (Ukraine). Inst. Teoreticheskoj Fiziki. 1991. 17p. Order Number DE93608287. Source: OSTI; NTIS (US Sales Only); INIS.

The reduced (d+1)-dimensional lattice QCD in the static gauge ${}_0A_0=0$ with staggered fermions at finite temperatures and nonzero chemical potential are presented. We suggest a d-dimensional model for the SU(2) QCD at high temperatures in term of d-dimensional scalar fields and Poliakov loops. Relations to G. Mack dielectric theory and Georgy-Glashow model are studied. 8 refs. (author).

4522 (ITP–91-64) **Tuning in phase structure analysis of lattice QCD at finite temperature.** Averchenkova, L.A.; Borisenko, O.A.; Petrov, V.K.; Zinov'ev, G.M. AN Ukrainskoj SSR, Kiev (Ukraine). Inst. Teoreticheskoj Fiziki. 1991. 13p. Order Number DE93608288. Source: OSTI; NTIS (US Sales Only); INIS.

The Bogoliubov's method of quasi averages is utilized to explore the phase structure of an effective action of finite temperature lattice QCD. Refining upon standard mean field analysis in such an approach we specify some features at deconfinement critical temperature. 15 refs.; 3 figs. (author).

4523 (ITP–91-79) **Q^2 evolution of a soft gluon distribution function.** Enkovszky, L.L.; Kotikov, A.V.; Paccanoni, F. AN Ukrainskoj SSR, Kiev (Ukraine). Inst. Teoreticheskoj Fiziki. 1991. 16p. Order Number DE93608289. Source: OSTI; NTIS (US Sales Only); INIS.

Recently a model for the soft gluon distribution function, $XG(X,Q^2)x->0\approx I^B(\ln 1/x)^B$, related to a double pomeron pole exchange, was suggested. Here we calculate the Q^2 dependence of its parameters in the framework of the GLAP evolution equation - both in LLA and double log approximation. The $\approx \ln 1/x$ behaviour appears to be unstable with respect to perturbation calculations. 11 refs.; 1 fig. (author).

4524 (SLAC-PUB–5917) **QCD on the light cone.** Brodsky, S.J. Stanford Linear Accelerator Center, Menlo Park, CA (United States). Sep 1992. 18p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC03-76SF00515. (CONF-9206302–1: QCD - 20 years later workshop, Aachen (Germany), 9-13 Jun 1992). Order Number DE93001822. Source: OSTI; NTIS; INIS; GPO Dep.

The quantization of gauge theory at fixed light-cone time $\tau = t - z/c$ provides new perspectives for solving non-perturbative problems in quantum chromodynamics. The light-cone Fock state expansion provides both a precise definition of the relativistic wavefunctions of hadrons as bound-states of quarks and gluons and a general calculus for predicting QCD processes at the amplitude level. Applications to exclusive processes and weak decay amplitudes are discussed. The problem of computing the hadronic spectrum and the corresponding light-cone wavefunctions of QCD in one space and one time dimension has been successfully reduced to the diagonalization of a discrete representation of the light-cone Hamiltonian. The problems confronting the solution of gauge theories in 3 + 1 dimensions in the light-cone quantization formalism,, including zero modes and non-perturbative renormalization, are reviewed.

6623 Specific Interactions, Decays and Processes

Refer also to citation(s) 4026, 4490, 4569, 4570, 4576, 4615

4525 (BNL–47950) **A lattice calculation of the decay constants of heavy-light pseudoscalars.** Labrenz, J.N. Brookhaven National Lab., Upton, NY (United States). Aug 1992. 166p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC02-76CH00016. Order Number DE93000379. Source: OSTI; NTIS; INIS; GPO Dep.

Thesis submitted to Univ. of California, Los Angeles.

A lattice calculation of the decay constants for D and B mesons is described. Results are obtained (in the quenched approximation) from wall-source lattices in Coulomb gauge at $\beta = 6.3$, through a procedure that interpolates smoothly between the static approximation of Eichten and the conventional ("heavy" Wilson fermion) method. The previously observed discrepancy between these two approaches has been understood, and we discuss the resolution and its limitations. We find $f_D = 206(9) \pm 37$ MeV, $f_{D_s} = 231(7) \pm 39$ MeV, $f_B = 179(10) \pm 39$ MeV, and $f_{B_s} = 203(8) \pm 42$ MeV. The first error in each result is statistical, resulting from the jackknife procedure applied to the full analysis. The second is our estimate of systematic errors due to scale-breaking, axial current renormalization, and fitting or extrapolation uncertainties.

4526 (BNL–47972) **Workshop on hadron structure from photo-reactions at intermediate energies: Proceedings.** Nathan, A.M.; Sandorfi, A.M. (eds.). Brookhaven National Lab., Upton, NY (United States). [1992]. 148p. Sponsored by USDOE, Washington, DC (United States); Illinois Univ., Urbana, IL (United States). DOE Contract AC02-76CH00016. (CONF-9205234–: Workshop on hadron structure from photo-reactions at intermediate

energies, Brookhaven, NY (United States), 28-29 May 1992). Order Number DE93001904. Source: OSTI; NTIS; INIS; GPO Dep.

This report contains papers on the following topics: The proton compton effect: Recent measurements of the electric and magnetic polorizabilities of the proton; experiments on the electric polarizability of the neutron; chiral symmetry and nucleon polarizabilities; chiral model predictions for electromagnetic polarizabilities of the nucleon, a consumer report; the polarizabilities of bound nucleons; nucleon polarizability in free space and in nuclear matter; mechanisms of photon scattering on nucleons at intermediate energies; pion polarizabilities in chiral perturbation theory; pion polarizabilities and the shielding of $\sigma(700)$-meson exchange in $\gamma\gamma\to\pi\pi$ processes; pion and kaon polarizabilities in the quark confinement model; radiative pion photoproduction and pion polarizabilities; pion and sigma polarizabilities and radiative transitions; the quadrupole amplitude in the γN-Δ transition; pion photoproduction and the γN-Δ amplitudes; effective- lagrangians, Watson's theorem, and the E2/M1 mixing ratio in the excitation of the delta resonance; new measurements of the $p(\vec{\gamma}, \pi^o)$ reaction; multipole analyses and photo-decay couplings at intermediate energies; compton scattering off the proton; connections between compton scattering and pion photoproduction in the delta region; single-pion electroproduction and the transverse one-half and scalar helicity transition form factors; relativistic effects, QCD mixing angles, and $N \to N\gamma$ and $\Delta \to \gamma N$ transition form factors; electroproduction studies of the $N \to \Delta$ transition at bates and CEBAF.

4527 (BNL–48118) **Strangeness signals in heavy ion collisions.** Remsberg, L.P. Brookhaven National Lab., Upton, NY (United States). [1992]. 6p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC02-76CH00016. (CONF-920837–19: ICHEP-26: 26th International Union of Pure and Applied Physics (IUPAP) conference on high energy physics, Dallas, TX (United States), 6-12 Aug 1992). Order Number DE93002935. Source: OSTI; NTIS; INIS; GPO Dep.

The experimental data on strange meson and strange baryon production in relativistic heavy ion collisions are reviewed.

4528 (CBPF-NF–036/91) **On the decay $D_s^+ \to$ p n-bar.** Bediaga, I.; Predazzi, E. Centro Brasileiro de Pesquisas Fisicas (CBPF), Rio de Janeiro, RJ (Brazil). 1991. 9p. Order Number DE93608348. Source: OSTI; NTIS (US Sales Only); INIS.

Summary classical arguments are used to show that the decay $D^+_s \to$ p n-bar could be an indicator of whether or not the axial current is conserved at large q^2. Keeping the π (1300) as the most relevant contribution to the form factor associated to the four divergence of the axial constant we find indications that the decay BR ($D^+_s \to$ p n-bar) could be as large as $\approx$ 1%. (author).

4529 (DESY–92-071) **Biolocal field approach and semileptonic heavy meson decays.** Kalinovsky, Y.L. (Joint Inst. for Nuclear Research, Dubna (Russia)); Kaschluhn, L. Deutsches Elektronen-Synchrotron (DESY), Zeuthen (Germany). Inst. fuer Hochenergiephysik. May 1992. 28p. Order Number DE93728756. Source: OSTI; NTIS (US Sales Only); INIS.

In this paper we consider the bilocal field approach for QCD. We obtain a bilocal effective meson action with a potential kernel given in relativistic covariant form. THe corresponding Schwinger-Dyson and Bethe-Salpeter equations are investigated in detail. By introducing weak interactions into the theory we study heavy meson properties as decay constants and semileptonic decay amplitudes. Thereby, the transition from the bilocal field description to the heavy quark effective theory is discussed. Considering as example the semileptonic decay of a pseudoscalar B-meson into a pseudoscalar D-meson we obtain an integral expression for the corresponding Isgur-Wise function in terms of meson wave functions. (orig.).

4530 (DESY–92-073) **Photon induced reactions at HERA.** Levy, A. (Deutsches Elektronen-Synchrotron (DESY), Hamburg (Germany)). Deutsches Elektronen-Synchrotron (DESY), Hamburg (Germany). May 1992. 20p. (CONF-9203167–: International symposium on micromechanics: homogenization, heterogenization and strength, La Jolla, CA (United States), 27-29 Mar 1992). Order Number DE93728747. Source: OSTI; NTIS (US Sales Only); INIS.

Some phenomenological and experimental issues concerning photoproduction at HERA are discussed. This includes the total photoproduction cross section, light and heavy quark photoproduction, determination of parton densities in the proton and in the photon and the photon-photon possibilities at HERA. (orig.).

4531 (DESY–92-078) **Real and virtual photon contributions to inelastic ep scattering.** Borzumati, F.M. (Hamburg Univ. (Germany). 2. Inst. fuer Theoretische Physik); Schuler, G.A. Deutsches Elektronen-Synchrotron (DESY), Hamburg (Germany). Jun 1992. 31p. Contract BMFT 054HH92P. (CERN–6519/92;MPI-Ph–91-113). Order Number DE93728833. Source: OSTI; NTIS (US Sales Only); INIS.

We investgate direct and resolved photon contributions to hard ep scattering at high energies. Some terms of the direct contribution are already included in the resolved photon one, described in terms of the photon structure functions. A suitable subtraction mechanism has to be found in order to avoid double counting. Inelastic ep scattering requires the knowledge of photon structure functions over a wide range in photon virtuality, in particular from approximately zero up to almost $10^5 GeV^2$ at HERA. We analyse the real and virtual photon structure function and we comment on the structure of the photon in the intermediate region of low virtuality. We finally describe how ep cross sections can be obtained as functions of the virtuality of the exchanged photon. (orig.).

4532 (DESY–92-082) **Measurement of the decay $\tau^- \to \rho^- \nu_\tau$.** Albrecht, H. (Deutsches Elektronen-Synchrotron (DESY), Hamburg (Germany)); Ehrlichmann, H.; Hamacher, T.; Hofmann, R.P.; Kirchhoff, T.; Nau, A.; Nowak, S.; Schroeder, H.; Schulz, H.D.; Walter, M.; Wurth, R.; Appuhn, R.D.; Hast, C.; Kolanoski, H.; Lange, A.ARGUS Collaboration. Deutsches Elektronen-Synchrotron (DESY), Hamburg (Germany). Jun 1992. 16p. Contract BMFT 054DO51P;BMFT 054ER12P;BMFT 055HD21P;BMFT 054KA17P Order Number DE93728831. Source: OSTI; NTIS (US Sales Only); INIS.

An analysis of the decay $\tau^- \to \pi^- \pi^o \nu_\tau$ has been performed using the ARGUS detector at the DORIS II storage ring. The branching ratio has been determined to be $Br(\pi^- \to \pi^- \pi^o \nu_\tau) = (22.6 \pm 0.4 \pm 0.9)\%$. The spape of the $\pi^- \pi^0$ invariant mass spectrum is found to be in good agreement with the predictions obtained using the conserved vector current (CVC) hypothesis, suggesting that the $\pi^- \pi^0$ system is produced in a $J^P = 1^-$ state. An analysis of the measured decay angular distribution of the pions with respect to the flight direction of the $\pi^- \pi^0$ system demonstrates the vector nature of the coupling at the $\tau\nu_\tau$ vertex. With the assumption of zero ν_τ mass the ν_τ spin has been shown to be $J_{\nu\tau} = 1/2$. (orig.).

4533 (DESY–92-085) **Heavy quark physics at HERA.** Ali, A. Deutsches Elektronen-Synchrotron (DESY), Hamburg (Germany). Jun 1992. 16p. (CONF-9204210–: 1992 Zeuthen workshop on elementary particle theory: Deep inelastic scattering, Teupitz (Germany), 6-10 Apr 1992). Order Number DE93728894. Source: OSTI; NTIS (US Sales Only); INIS.

A brief overview of the anticipated heavy quark physics at HERA is given. The topics discussed include heavy quark photo- and leptoproduction cross sections at HERA calculated in the context of perturbative QCD, various mechanisms of J/ψ-leptoproduction and their rates, determination of the gluon density of the proton using open and bound charmed hadrons, and rare D^0-meson decays. Some selected aspects of B-Physics at HERA are also discussed. (orig.).

4534 (DESY–92-089) **Prompt photon energy spectra in B-decays and determination of the CKM matrix elements.** Ali, A. (Deutsches Elektronen-Synchrotron (DESY), Hamburg (Germany)); Greub, C. Deutsches Elektronen-Synchrotron (DESY), Hamburg (Germany). Jun 1992. 20p. (ZU-TH–23/92). Order Number DE93728897. Source: OSTI; NTIS (US Sales Only); INIS.

We present theoretical estimtaes of the inclusive prompt photon energy spectrum in direct decays of B-hadrons through the charged current processes $B \to X_c + \gamma$ and $B \to X_u + \gamma$, and the flavour changing neutral current (FCNC) processes $B \to X_s + \gamma$ and $B \to X_d + \gamma$ (here the subscript q on X_q denotes the quark flavour in the transition $b \to q$). It is argued that the various components in the inclusive spectrum can, in principle, be disentangled using the photon energy and flavour tagging the hadron(s) recoiling against the

photon in B-decays, thereby providing a new technique to determine the CKM matrix elements vertical strokeV_{cb}vertical stroke, vertical strokeV_{ub}vertical stroke, vertical strokeV_{ts}vertical stroke, and vertical strokeV_{td}vertical stroke. In particular, the high energy part of the inclusive photon energy spectrum being dominated by the electromagnetic penguins could provide the first direct measurement of the CKM matrix element vertical strokeV_{ts}vertical stroke. We quantify this by firming up predictions for the inclusive decays $B \rightarrow X_s + \gamma$ in the Standard Model. (orig.).

4535 (DESY–92-090) **B-decays - an overview.** Ali, A. Deutsches Elektronen-Synchrotron (DESY), Hamburg (Germany). Jun 1992. 18p. (CONF-9203154–: 27. Moriond meeting: Quantum Chromodynamics (QCD) and high energy hadronic interactions, Les Arcs (France), 22-28 Mar 1992). Order Number DE93728893. Source: OSTI; NTIS (US Sales Only); INIS.

We review some selected aspects of B-decays in the context of the Standard Model and the Cabibbo-Kobayashi-Maskawa theory of weak mixing. The calculational framework used is based on perturbative QCD. The topics discussed include an update of the CKM matrix parameters, estimates of the inclusive B-decay rates in the context of the QCD improved spectator model, and inclusive rare B-decays $B \rightarrow X_s + \gamma$ and $B \rightarrow X_d + \gamma$. Exclusive branching ratios $BR(B \rightarrow K^* + \gamma)$ and $BR(B \rightarrow \rho + \gamma)$ are also presented. The importance of rare B-decays in determining the CKM matrix elements is emphasized. (orig.).

4536 (DESY–92-097) **KROWIG, Version 1.0: Interfacing KRONOS and HERWIG or higher order electromagnetic radiative corrections at HERA with hadronic final states.** Ohl, T. Deutsches Elektronen-Synchrotron (DESY), Hamburg (Germany). Jul 1992. 24p. Order Number DE93728888. Source: OSTI; NTIS (US Sales Only); INIS.

This manual describes version 1.0 of the Monte Carlo event generator KROWIG for deep inelastic lepton hadron scattering at HERA. KROWIG combines the implementation of QED radiative corrections in KRONOS with the QCD parton showers and cluster fragmentation of HERWIG. (orig.).

4537 (DESY–92-098) **The dipole model structure functions.** Andersson, B. (Lund Univ. (Sweden). Dept. of Theoretical Physics); Loennblad, L. Deutsches Elektronen-Synchrotron (DESY), Hamburg (Germany). Jul 1992. 20p. (LU-TP–92-21). Order Number DE93728889. Source: OSTI; NTIS (US Sales Only); INIS.

We present an approach to the evolution of the valence structure functions based on the Colour Dipole Cascade Model for deep inelastic lepto-production. We show that this approach leads to an evolution equation similar to the DGLAP equation. In our approach the dependence on Q^2 is however much weaker and the evolution levels out at high Q^2. (orig.).

4538 (DESY–92-103) **Quark/gluon jet discrimination at HERA.** Pumplin, J. (Michigan State Univ., East Lansing, MI (United States). Dept. of Physics and Astronomy). Deutsches Elektronen-Synchrotron (DESY), Hamburg (Germany). Jul 1992. 24p. Order Number DE93728895. Source: OSTI; NTIS (US Sales Only); INIS.

Tests of QCD, and its representation by Monte Carlo shower models such as PYTHIA or HERWIG, are proposed for low-Q^2 events at the e^-p collider HERA. The tests are based on observable features that distinguish between quark jets and gluon jets. They therefore provide sensitivity to the description of parton branching, and to the parton distributions in the photon and proton. (orig.).

4539 (DESY–92-106) **On the origin of the enhancement of CP-violating charge asymmetries in $K^{\pm} \rightarrow 3\pi$ decays predicted from chiral theory.** Bel'kov, A.A. (Joint Inst. for Nuclear Research, Moscow (Russia). Particle Physics Lab.); Lanyov, A.V.; Ebert, D.; Bohm, G.; Schaale, A. Deutsches Elektronen-Synchrotron (DESY), Zeuthen (Germany). Inst. fuer Hochenergiephysik. Jul 1992. 17p. (CONF-920837–: 26. international IUPAP conference on high energy physics, Dallas, TX (United States), 6-12 Aug 1992). Order Number DE93728892. Source: OSTI; NTIS (US Sales Only); INIS.

We present an analysis of the enhancement of CP-violating charge asymmetries in $K^{\pm} \rightarrow 3\pi$ decays. Calculations of decay amplitudes are performed on the basis of bosonized strong and weak Lagrangians derived from QCD-motivated quark Lagrangians. We show that the interplay of fourth-order contributions of chiral Lagrangians for strong interactions and penguin operators in weak interactions significantly enhances the charge asymmetries. (orig.).

4540 (DESY–92-112) **A determination of the Zbanti b vertex correction from LEP data.** Blondel, A. (Ecole Polytechnique, IN2P3, 91 - Palaiseau (France)); Verzegnassi, C.; Djouadi, A. Deutsches Elektronen-Synchrotron (DESY), Hamburg (Germany). Aug 1992. 11p. Order Number DE93728877. Source: OSTI; NTIS (US Sales Only); INIS.

Using recent LEP measurements of the ratios of Z bosons widths Γsub(Z→b anti b)/$\Gamma_{Z \rightarrow hadrons}$ and $\Gamma_{Z \rightarrow hadrons}/\Gamma_{Z \rightarrow leptons}$, we determine the size of the vertex radiative correction to the Z → banti b partial decay width. This allows, in the context of the Minimal Standard Model, to set the 95% confidence level upper bound on the top quark mass, $m_t < 208$ GeV independently of the Higgs boson mass. This value is remarkably close to the completely independent available bounds, which are extracted from the measurement of the radiative correction to the ρ parameter. The implication of possible New Physics on this measurement is briefly commented upon. (orig.).

4541 (DESY–92-113) **Radiative rare B decays into higher K-resonances.** Ali, A. (Deutsches Elektronen-Synchrotron (DESY), Hamburg (Germany)); Ohl, T.; Mannel, T. Deutsches Elektronen-Synchrotron (DESY), Hamburg (Germany). Aug 1992. 15p. (IKDA–92/23). Order Number DE93728878. Source: OSTI; NTIS (US Sales Only); INIS.

We estimate the contributions of higher K-resonances to the radiative rare decays b → sγ. We use the spin symmetry for heavy quarks to reduce the number of independent form factors to four Isgur-Wise functions, which are estimated from the wave function model of Isgur, Scora, Grinstein, and Wise. Our results suggest a substantially larger branching fraction for the decay B → $K^*_2(1430)\gamma$ than previous investigations. (orig.).

4542 (DOE/ER/10713–T3) **[Study of electroweak interactions]: Technical progress report, September 1, 1990–August 31, 1991.** Virginia Polytechnic Inst. and State Univ., Blacksburg, VA (United States). Dept. of Physics. [1991]. 40p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AS05-80ER10713. Order Number DE93004367. Source: OSTI; NTIS; INIS; GPO Dep.

This document is a technical progress report for research conducted at Virginia Tech under DOE contract of "Study of Electron-Positron Interactions" # DE-AS05-80ER10713, Task B, during the past year. The report is divided into three main sections, dealing with the three primary activities of the group: the AMY experiment at TRISTAN (hardware upgrade, inclusive and isolated photon production, study of Bhabha scattering, electron substructure, and extra Z bosons, production of Λ^0 and Λ^0, and QED and search for pair production of massive photinos), the MEAGER/RHO experiemnt at LAMPF (planning and data acquisition for the decays $\mu^+ \rightarrow e^+\gamma$ and $\mu^+ \rightarrow e^+\nu_e\bar{\nu}_\mu$), and an r and d program on resistive plate chamber development at Virginia Tech.

4543 (DOE/ER/40390–5) **Experiments on the nuclear interactions of pions and electrons: Progress report.** Minehart, R.C.; Ziock, K.O.H. Virginia Univ., Charlottesville, VA (United States). Dept. of Physics. Aug 1992. 31p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG05-88ER40390. Order Number DE93001800. Source: OSTI; NTIS; INIS; GPO Dep.

The analysis of the deuterium content in the CD target used in an experiment to study the $\pi + d \rightarrow 2p$ reaction at incident pion energies from 4 to 20 MeV was completed. The final paper describing this experiment will be submitted for publication this summer. Analysis of LAMPF Exp. on pion absorption in ^{4}He is continuing. In 1991, we collaborated with D. Pocanic from the Univ. of Virginia on a measurement at LAMPF of the π^0 production in π + p interactions. This run proved the validity of the method and additional data were obtained in a second run during the summer of 1992, using a new target. Current collaborations at LAMPF include the search for the decay $\mu^+ \rightarrow e^+ + \gamma$(MEGA) and a measurement of the Michel ρ parameter in the decay $\mu \rightarrow e + \nu + \nu$. A U.Va.–PSI collaboration is measuring pion beta decay to an accuracy of

less than 1%, using a large acceptance CsI detector to measure the π^0 following decay of stopped π^+ mesons. Most of the U.Va. effort is devoted to the CEBAF Large Acceptance Spectrometer (CLAS) program to the construction of the CLAS forward calorimeter. An apparatus to measure the properties of the scintillators with light from a N_2 laser was built in the spring of 1992. The electronic circuitry for the energy signal from the EGN detector and the circuitry needed to route the signals from the all the photomultipliers to the TDC and ADC circuits are being developed. Experimental proposals for the study of electroproduction of nucleon resonances at CEBAF, including measurements with polarized beam and targets, are being developed.

4544 (DOE/ER/40412–T1) **The study of the phase structure of hadronic matter by searching for the deconfined quark-gluon phase transition using 2 TeV $\bar{p}p$ collisions; and by searching for critical phenomena in an exclusive study of multifragmentation using 1 GeV/nucleon heavy ion collisions: Progress report, January 1, 1992–December 31, 1992.** Scharenberg, R.P.; Hirsch, A.S.; Tincknell, M.L. Purdue Univ., Lafayette, IN (United States). Dept. of Physics. 15 Sep 1992. 36p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG02-88ER40412. Order Number DE93002094. Source: OSTI; NTIS; INIS; GPO Dep.

An experiment to search for the production of quark–gluon plasma in proton–antiproton interactions is described with emphasis on 1992 results. Next, a search for critical phenomena using the EOS Time Projection Chamber is similarly described, including the results of 1992 test runs, nucleus–nucleus collision simulations, and the extraction of critical indices from small percolation lattices. Analysis of results from experiments to detect the possible production of anomalous photons in the central rapidity region with transverse momentum between 5 and 50 MeV/c are discussed. Initial work on an experiment to study the high-density, high-temperature state of matter formed in collisions of heavy nuclei at relativistic energies, planned to begin in fall 1997, is related. Finally, work on a research and development project to investigate silicon avalanche diodes as time-of-flight detectors for nuclear and particle physics applications is reviewed. The principle is to detect the ionization of charged particles directly in the Si; feasibility has been demonstrated.

4545 (DOE/ER/40454–T2) **Partial-wave analyses of hadron scattering below 2 GeV: Progress report, May 1992–April 30, 1993.** Arndt, R.A.; Roper, L.D. Virginia Polytechnic Inst. and State Univ., Blacksburg, VA (United States). Dept. of Physics. [1992]. 6p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG05-88ER40454. Order Number DE93004368. Source: OSTI; NTIS; INIS; GPO Dep.

The Center for Analysis of Particle Scattering (CAPS) in the Department of Physics at Virginia Polytechnic Institute and State University has analyzed basic two-body hadron reactions below 2 GeV for the last two decades. Reactions studied were nucleon-nucleon, pion-nucleon, K+-nucleon and pion photoproduction systems. In addition to analyses of these reactions, a computer graphics system (SAID) has been developed and disseminated to over 250 research institutions using VAX computers. The computer-interactive system for disseminating information on basic scattering reactions is also accessible to the physics community through TELNET on the VPI&SU physics department VAX.

4546 (DOE/ER/40651–3) **Experimental studies of elementary particle interactions at high energies: Technical progress report.** Goulianos, K. Rockefeller Univ., New York, NY (United States). 1 Oct 1992. 73p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG02-91ER40651 ;AC02-87ER40325. Grant RGFY 9160;Grant RGFY 9260;Grant RGFY 92128. (RU–92/E-36). Order Number DE93003652. Source: OSTI; NTIS; INIS; GPO Dep.

In the past year, our research program encompassed four major areas: the UA-6 experiment at CERN, the CDF (Collider Detector at Fermilab) experiment at Fermilab, the SDC (Solenoidal Detector Collaboration) experiment of the SSC (Superconducting Super Collider), and an R&D project for the development of High Pressure Gas Calorimetry for high luminosity colliders. The UA-6 experiment studies direct-γ and J/ψ production in pp and $\bar{p}p$ interactions at $\sqrt{s}$ = 22.5 GeV. In the CDF experiment we have concentrated in the plug calorimeter upgrade program, which involves replacing the plug and forward calorimetry with a more compact calorimeter based on scintillator tiles being readout with wave-length shifting (WLS) fibers. In the SDC experiment, we have taken primary responsibility for the Preshower/Shower-Maximum detectors. We wrote the original shower-maximum proposal for the SDC and have contributed to detector simulations, scintillator/WLS-fiber light yield measurements, building prototype preshower and shower-maximum detectors and measuring their performance in a test beam, and developing novel photosensitive devices to read out the fibers. The High Pressure Gas Calorimeter project has been very successful. A prototype parallel plate iron based electromagnetic calorimeter was designed, constructed and tested in an electron beam at Fermilab. The results were very encouraging. We are presently working on a new design, which would be more suitable for the construction of economical, large scale calorimeters, such as those needed for the forward region of SDC and FAD.

4547 (DOE/ER/40682–5) **Measurement of the branching ratio for $D^+ \to \bar{K}^*(892)^0 \mu^+\nu$.** Fermilab E653 Collaboration. Carnegie-Mellon Univ., Pittsburgh, PA (United States). [1992]. 22p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG02-91ER40682. (CMU-HEP–92-10). Order Number DE93002414. Source: OSTI; NTIS; INIS; GPO Dep.

The branching ratio for the decay mode $D^+ \to \bar{K}^{*0} \mu^+\nu$ has been measured with two methods. The first uses $D^0 \to \bar{K}^- \mu^+\nu$ for normalization, and yields the result $B(D^+ \to \bar{K}^{*0} \mu^+\nu) = (3.25 \pm 0.71 \pm 0.75)\%$. From this method we also obtain the direct measurement $\Gamma(D^+ \to \bar{K}^{*0}\mu^+\nu)/\Gamma(D^0 \to K^- \mu^+\nu) = 0.43 \pm 0.09 \pm 0.09$. The second method uses the mode $D^+ \to K^-\pi^+\pi^+$ for normalization and yields $B(D^+ \to \bar{K}^{*0} \mu^+\nu) = 4.18 \pm 0.66 \pm 0.96)\%$. Combining the results of the two methods yields $B(D^+ \to \bar{K}^{*0}\mu^+\nu) = 3.57 \pm 0.96)\%$.

4548 (GSI–92-51(prepr.)) **Two photon physics with heavy-ion collisions and photons produced by channeled electrons.** Schaefer, A. (Frankfurt Univ. (Germany). Inst. fuer Theoretische Physik); Augustin, J.; Best, C.; Klenner, J.; Hofmann, C.; Schneider, S.M.; Solovyov, A.; Greiner, W.; Soff, G. Gesellschaft fuer Schwerionenforschung mbH, Darmstadt (Germany). Aug 1992. 14p. Order Number DE93729017. Source: OSTI; NTIS (US Sales Only); INIS.

Photon-Photon physics at very high energies offers interesting possibilities. One can search for new particles, both for expected ones like the top quark or the higgs particle, as well as exotic ones like supersymmetric particles. It might also be possible to determine important properties of known particles like e.g. the anomalous magnetic moment of the W boson. To do such experiments one needs photons in the 100 GeV range. We investigated two potential sources for such hard photons, namely the equivalent photons of heavy ion collisions and the photons produced in high-energy channeling. (orig.).

4549 (IC–92/209) **$B \to Kl^+l^-$ decay in supersymmetric theories.** Aliev, T.M. (Istanbul Univ., Istanbul (Turkey). Physics Dept.); Yilmaz, O.; Turan, G. International Centre for Theoretical Physics, Trieste (Italy). Aug 1992. 18p. Grant AFP-92-01-0508. Order Number DE93608349. Source: OSTI; NTIS (US Sales Only); INIS.

In this work, the weak decay $B \to Kl^+l^-$ is studied in the framework of the Standard Model (SM) and the Supersymmetric Model (SUSY). It is found that in some mass regions the contribution of the SUSY to the decay rate is larger than the effects of SM. The numerical values we have obtained for branching ratio (BR) show that it can be measured in future experiments of B-factories. It is also shown that there exists some restriction on the masses of the SUSY particles $m\text{-}bar_g$ and $m\text{-}bar_{3/2}$ which follow from the observed values of BR. (author). 13 refs, 8 figs.

4550 (INP–1540/PH) **A constituent quark model with colour degrees of freedom confronts the data on hadron-nucleus interactions.** Rozanska, M.; Jezabek, M. Institute of Nuclear Physics, Cracow (Poland). Apr 1991. 17p. Grants CPBP 01.03 and 01.09. Order Number DE93608324. Source: OSTI; NTIS (US Sales Only); INIS.

Three version of a model with colour excitations of constituent quarks are examined using inclusive leading proton and antiproton

spectra in nuclear interactions at high energies. The comparison with experimental data excludes the models in which fragmentation into leading final hadrons depends only on the colour charge of constituents in an intermediate system. (author).

4551 (INP–1554/PH) **F_0 (975) meson and the KK-bar threshold effects.** Cannata, F. (Bologna Univ. (Italy). Ist. di Fisica); Dedonder, J.P.; Lesniak, L. Institute of Nuclear Physics, Cracow (Poland). Jul 1991. 10p. Order Number DE93608325. Source: OSTI; NTIS (US Sales Only); INIS.

f_0 (975) meson properties in a vicinity of the KK-bar threshold are studied using the separable potential formalism. The $\pi\pi$ and KK-bar elastic and inelastic cross sections are calculated for the isospin 0 and spin 0 channel. In particular we study KK-bar scattering length, the threshold behaviour of the inelasticity parameter and the branching ratio of the f_0 (975) meson decay. We discuss also the shape of the f_0 (975) lines as a function of the effective mass near KK-bar threshold. A comparison of the theoretical branching ratio with presently available data is done. (author).

4552 (ITP–91-34) **Supercritical pomeron and spin effects in meson-nucleon scattering at high energy.** Akkelin, S.V. AN Ukrainskoj SSR, Kiev (Ukraine). Inst. Teoreticheskoj Fiziki. 1991. 9p. Order Number DE93608327. Source: OSTI; NTIS (US Sales Only); INIS.

Helicity amplitudes of elastic πN-scattering and charge-exchange scattering in a supercritical pomeron model are calculated. It is shown that the polarization of elastic πN-scattering at fixed transferred momentum decreases as $\approx 1/\ln s$ and the charge-exchange scattering oscillates and tends to a constant with the increasing transferred momentum. 9 refs. (author).

4553 (ITP–91-45) **Cross channels unitarity conditions and equations for form factors.** Glushko, N.I. AN Ukrainskoj SSR, Kiev (Ukraine). Inst. Teoreticheskoj Fiziki. 1991. 12p. Order Number DE93608328. Source: OSTI; NTIS (US Sales Only); INIS.

The system of algebraic-differential equations for effective radius of the strong interaction and form factor is obtained by the unitary conditions in cross channels. The general solution of this system is found. Several specific cases are investigated, a distinction of the behaviour of fixed-angle differential cross-section due to different unitarization schemes is considered also. 14 refs. (author).

4554 (ITP–91-46) **Representation for the decay constant f_π in gauge theories.** Gusynin, V.P.; Kushnir, V.A. AN Ukrainskoj SSR, Kiev (Ukraine). Inst. Teoreticheskoj Fiziki. 1991. 20p. Order Number DE93608350. Source: OSTI; NTIS (US Sales Only); INIS.

Using the divergence of the axial-vector current as an interpolating operator for the pion field a representation for the pion decay constant is obtained which is more convenient for numerical calculations. Its connection with Langacker-Pagels and Pagels-Stokar formulae is established and the analysis of the integral equations for the pseudo-scalar vertex is given. In the so-called linearized approximation to the Schwinger-Dyson equation, an exact expression for the Pagels-Stockar formula is obtained during special functions. 15 refs.; 2 figs. (author).

4555 (ITP–91-99) **Odderon dominance in dipole model of hadron elastic scattering.** Martynov, E.S. AN Ukrainskoj SSR, Kiev (Ukraine). Inst. Teoreticheskoj Fiziki. 1991. 8p. Order Number DE93608329. Source: OSTI; NTIS (US Sales Only); INIS.

The contribution of the multiple Pomeron-Odderon cuts in elastic pp and p-barp scattering amplitudes at fixed transferred momenta is calculated. It is shown that the asymptotic behaviour of the pp- and p-barp- amplitudes is controlled by the parameters of the input Odderon rather than Pomeron, if the slope of Pomeron trajectory is larger than the slope of Odderon trajectory. 15 refs. (author).

4556 (ITP–91-100) **Nonlinear Pomeron and Odderon in elastic re-scatterings.** Akkelin, S.V.; Martynov, E.S. AN Ukrainskoj SSR, Kiev (Ukraine). Inst. Teoreticheskoj Fiziki. 1991. 13p. Order Number DE93608326. Source: OSTI; NTIS (US Sales Only); INIS.

A supercritical and dipole models of the elastic scattering with nonlinear trajectories of bare Pomeron and Odderon are considered. The unitary constraints on the parameters of the Odderon trajectory are obtained. The multiple Pomeron-Odderon cuts are calculated. Their contribution to the elastic amplitudes are shown to reproduce qualitatively the result obtained previously for the linear Pomeron and Odderon. The essential difference in the crossing-odd properties of supercritical and dipole models is noted. 18 refs. (author).

4557 (LBL–32861) **Introduction to physics studies at an asymmetric e^+e^- B-factory.** Oddone, P.J. Lawrence Berkeley Lab., CA (United States). Sep 1992. 7p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC03-76SF00098. (CONF-9204126–14: B factories: state of the art in accelerators, detectors, and physics, Stanford, CA (United States), 6-10 Apr 1992). Order Number DE93002573. Source: OSTI; NTIS; INIS; GPO Dep.

In this paper we present a brief summary of the CP violation physics to be undertaken at an asymmetric e^+e^- B factory.

4558 (SLAC–398) **Proceedings of Summer Institute on particle physics: Lepton-Hadron scattering.** Hawthorne, J. (ed.). Stanford Linear Accelerator Center, Menlo Park, CA (United States). Sep 1992. 566p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC03-76SF00515. (CONF-910836–: 19. Stanford Linear Accelerator Center (SLAC) summer institute on particle physics, Stanford, CA (United States), 5-16 Aug 1991). Order Number DE93002490. Source: OSTI; NTIS; INIS; GPO Dep.

The nineteenth annual SLAC Summer Institute on Particle Physics took place from August 5 to 16, 1991, attracting 236 participants from 10 different countries. The theme was lepton-hadron scattering, the subjects ranging from the pioneering SLAC-MIT experiments, through the new era of e-p collisions to be ushered in by HERA. Richard Taylor led off the Institute with a historical review of lepton-proton scattering experiments, from Rutherford to the 1960s, while Sid Drell laid out the theoretical framework, in terms of parton distributions and sum rules. Frank Sciulli picked up where Richard Taylor left off, at the discovery of scaling violation, and brought us up to the present. Joel Feltesse and Roberto Peccei described the physics opportunities at HERA, most notably the investigation of the low x behavior of structure functions. Traudl Hansl-Kozanecka reviewed the current experimental status of QCD, at e^+e^- and hadron colliders as well as in deep-inelastic lepton-hadron scattering. Bob Hollebeek lectured on techniques for electromagnetic and hadronic calorimetry. Finally, Bob Siemann gave a series of lectures on the many uses of superconductivity in particle accelerators, from bending magnets at FNAL HERA and the SSC to RF cavities at CEBAF and LEP. Following the school, the topical conference provided us with a spectrum of current experimental and theoretical developments. Lepton-hadron scattering experiments at CERN and Fermilab were well represented. The existence of the 17^0, keV neutrino was debated in two separate talks. We heard the latest results from the CDF and UA2 hadron collider experiments; from the four LEP experiments; and from ARGUS and CLEO. Also presented were overviews of the rare K decay program at BNL, the CP violation experiments at CERN and Fermilab, B physics, neutrino masses and mixings, and precision electroweak theory.

4559 (SLAC-PUB–5902) **First measurement of the left-right cross section asymmetry in Z boson production at E_{cm} = 91.55 GeV.** Rowson, P.C. (Columbia Univ., New York, NY (United States). Dept. of Physics). The SLD Collaboration. Stanford Linear Accelerator Center, Menlo Park, CA (United States). Nov 1992. 8p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC03-76SF00515. (CONF-920837–20: ICHEP-26: 26th International Union of Pure and Applied Physics (IUPAP) conference on high energy physics, Dallas, TX (United States), 6-12 Aug 1992). Order Number DE93004089. Source: OSTI; NTIS; INIS; GPO Dep.

The left-right cross section asymmetry for Z boson production in e^+e^- annihilation (A_{LR}) has been measured at E_{cm} = 91.55 GeV with the SLD detector at the SLAC Linear Collider (SLC) using a longitudinally polarized electron beam. The electron polarization was continually monitored with a Compton scattering polarimeter, and was typically 22%. We have accumulated a sample of ~10,200 Z events. We find that $A^{LR} = 0.100 \pm 0.044 \pm 0.003$ where the first error is statistical and the second is systematic. From this measurement, we determine the weak mixing angle defined at the Z boson pole to be $\sin^2\theta(\text{lept/w}) = 0.2378 \pm 0.0056$.

4560 (SLAC-PUB–5974) **A study of jet rates and measurement of α_s at the Z^0 resonance.** Lauber, J.A. (Colorado Univ., Boulder, CO (United States)). The SLD Collaboration. Stanford Linear Accelerator Center, Menlo Park, CA (United States). Nov 1992. 3p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC03-76SF00515. (COLO-HEP–293;CONF-921122–1: Meeting of the Division of Particles and Fields of the American Physics Society, Batavia, IL (United States), 10-14 Nov 1992). Order Number DE93004092. Source: OSTI; NTIS; INIS; GPO Dep.

We present jet rates in hadronic decays of Z^0 bosons measured by the SLD experiment at SLAC. The data are analyzed in terms of the JADE and recently proposed Durham algorithms, and are found to be in agreement with the predictions of perturbative QCD plus fragmentation Monte Carlo models of hadron production. Corrected 2, 3 and 4-jet rates are well described by $o(\alpha_s^2)$ perturbative QCD calculations. From fits to the differential 2-jet distribution the strong coupling $\alpha_s(M_Z)$ is measured to be $\alpha_s(M_Z)$ = 0.119 ± 0.002(stat.) ± 0.003(exp.syst.) ± 0.014(theory) (preliminary). The largest contribution to the error arises from the theoretical uncertainty in choosing the QCD renormalisation scale.

4561 (SLAC-PUB–5976) **A test of the flavor independence of α_s at the Z^0 resonance.** Junk, T.R. (Stanford Univ., CA (United States). Dept. of Physics). The SLD Collaboration. Stanford Linear Accelerator Center, Menlo Park, CA (United States). Nov 1992. 4p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC03-76SF00515. (CONF-921122–2: Meeting of the Division of Particles and Fields of the American Physics Society, Batavia, IL (United States), 10-14 Nov 1992). Order Number DE93004093. Source: OSTI; NTIS; INIS; GPO Dep.

We compare the ratio of the strong coupling α_s measured in $Z^0 \rightarrow b\bar{b}$ events to that measured in $Z^0 \rightarrow q\bar{q}(q=u,d,s,c)$ in the SLD experiment at SLAC. $Z^0 \rightarrow b\bar{b}$ events are identified with the aid of a precision silicon vertex detector by requiring that at least three charged tracks pass more than 3.0σ from the Z^0 decay vertex. This method has an estimated efficiency of 54% with a purity of 71%. Jets are identified and counted by clustering charged tracks according to the JADE algorithm. By comparing the 3-jet fraction in tagged events to that in all hadronic events, we extract a preliminary result of $\alpha_s(b)/\alpha_s(udsc) = 1.18 \pm 0.11(stat) \pm 0.05(sys)$.

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Refer also to citation(s) 4488, 4508, 4513, 4514, 4519, 4532, 4540, 4559

4562 (BNL–47932) **Introduction to lattice gaugefixing and effective quark and gluon masses.** Bernard, C. (Washington Univ., St. Louis, MO (United States). Dept. of Physics); Soni, A.; Yee, K. Brookhaven National Lab., Upton, NY (United States). [1992]. 5p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC02-76CH00016 ;FG05-91ER40617 ;FG02-91ER40628. (CONF-9206280–2: Workshop on QCD vacuum structure, Paris (France), 1-5 Jun 1992). Order Number DE93001433. Source: OSTI; NTIS; INIS; GPO Dep.

We report on the status of quark and gluon propagators in quenched, gaugefixed lattice QCD. In Landau gauge we find that the effective quark mass in the chiral limit is $M_q \sim 350(40)$MeV. Quark and gluon propagators, the slope of the quark dispersion relation, and effective masses all appear to depend on gauge. A link-chain picture of lattice gaugefixing in the color $N \rightarrow \infty$ and strong coupling limit, where the system becomes almost solvable, supports the gauge variance of these numerical results.

4563 (CBPF-NF–041/91) **On the physical content of the S U(2) Skyrme model.** Mignaco, J.A.; Wulck, S. Centro Brasileiro de Pesquisas Fisicas (CBPF), Rio de Janeiro, RJ (Brazil). 1991. 53p. Order Number DE93608376. Source: OSTI; NTIS (US Sales Only); INIS.

The solutions for the Skyrme model in the hedgehog SU (2) representation are analyzed as a function of the parameters of the model. Sum rules obtained from the Euler-Lagrange differential equations are efficient tools for this analysis, and use is made also of the original Derrick's argument regarding stability in a constructive way. (author).

4564 (DESY–92-087) **One loop corrections to the lightest Higgs mass in the minimal η model with a heavy Z'.** Comelli, D. (Trieste Univ. (Italy). Dept. of Theoretical Physics); Verzegnassi, C. Deutsches Elektronen-Synchrotron (DESY), Hamburg (Germany). Jun 1992. 17p. Order Number DE93728898. Source: OSTI; NTIS (US Sales Only); INIS.

We have evaluated the one loop correction to the bound on the lightest Higgs mass valid in the minimal, E_6 based, supersymmetric η model in the presence of a 'heavy' Z', $M_{Z'} \geq 1$ TeV. The dominant contribution from the fermion sfermion sector increases the 108 GeV tree level value by an amount that depends on the top mass in a way that is largely reminescent of minimal SUSY models. For $M_t \leq 150$ GeV, Msub(t tilde)=1 TeV, the 'light' Higgs mass is always ≤ 130 GeV. (orig.).

4565 (DESY–92-109) **Screening of large exotic scales in the light Higgs mass bound for a general class of supersymmetric models.** Comelli, D. (Trieste Univ. (Italy). Dept. of Theoretical Physics); Verzegnassi, C. Deutsches Elektronen-Synchrotron (DESY), Hamburg (Germany). Jul 1992. 12p. Order Number DE93728875. Source: OSTI; NTIS (US Sales Only); INIS.

We consider the class of supersymmetric models whose Higgs sector contains a 'conventional' couple of $SU(2)_L$ doublets and an arbitrary number of extra 'exotic' $SU(2)_L xU(1)_y$ neutral Higgs (possibly related to an extra symmetry group G), with a priori arbitrarily large vevs. We show that, as a consequence of the functional structure of the scalar potential (dictated by gauge and supersymmetry invariance), a general property exists in the scalar mass matrix which decouples the lightest Higgs mass from the large vevs effects at tree level. At one loop, we show that, if the fermion-sfermion sector is considered, the analogous property 'screens' the lightest Higgs mass under very general assumptions for the symmetry breaking mechanism. (orig.).

4566 (DOE/ER/40150–200) **What do we know about the Q^2 evolution of the Gerasimov-Drell-Hearn sum rule?.** Burkert, V. (Continuous Electron Beam Accelerator Facility, Newport News, VA (United States)); Li, Z. Southeastern Universities Research Association, Inc., Newport News, VA (United States). [1992]. 20p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84ER40150. (CEBAF-PR–92-017). Order Number DE93000828. Source: OSTI; NTIS; INIS; GPO Dep.

We study contributions from baryon resonance excitations to the Q^2 dependence of the Gerasimov-Drell-Hearn sum rule. The results indicate that the sum rule at small Q^2 is largely saturated by contribution from the lower mass resonant states. We find a strong Q^2 dependence of the resonant contributions, leading even to a sign change of the sum rule integral at $Q^2 \simeq 0.8 GeV^2$. The global Q^2 dependence indicates discrepancies to the interpretation of the EMC polarized structure function data on A_1^p in the resonance region, which can be largely attributed to the elimination of the $P_{33}(1232)$ resonance from the EMC analysis.

4567 (DOE/ER/40682–3) **Neutrino masses and solar neutrinos.** Wolfenstein, L. Carnegie-Mellon Univ., Pittsburgh, PA (United States). Dept. of Physics. [1992]. 5p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG02-91ER40682. (CMU-HEP–92-08). Order Number DE93002416. Source: OSTI; NTIS; INIS; GPO Dep.

It has been pointed out by Bahcall and Bethe and others that all solar neutrino data can be explained by MSW oscillations with $m(\nu_\mu) \sim 10^{-3}$ eV consistent with ideas grand unified theories (GUTS). There is a second possibility consistent with GUTS ideas with $m(\nu_\tau) \sim 10^{-2}$ eV and $m(\nu_\mu) \sim 10^{-4}$ eV. The two cases can be distinguished by a measurement of the solar neutrinos from ^7Be.

4568 (IC–92/199) **Radiative electroweak breaking and sparticle spectroscopy with tan $\beta \simeq (m_t)/m_b$.** Ananthanarayan, B. (International Centre for Theoretical Physics, Trieste (Italy)); Shafi, Q.; Lazarides, G. International Centre for Theoretical Physics, Trieste (Italy). Aug 1992. 17p. Grant DE-FG02-91ER40626;Grant

CRG-910573. (BA–92-29;PRL-TH–92/16.). Order Number DE93608399. Source: OSTI; NTIS (US Sales Only); INIS.

We explore radiative electroweak breaking and the related issue of sparticle spectroscopy within a N=1 supergravity framework in which the Yukawa couplings h_t, h_b and h_τ are unified at the GUT scale. The parameter tanβ of the minimal supersymmetric standard model (MSSM) is constrained to lie close to $(m_t)/m_b >> 1$. With $m_t(m_t)$ > or approx. 130 GeV, analysis based on the renormalization group improved tree level potential shows that in order to achieve a satisfactory radiative breaking, the universal gaugino mass $M_{1/2}$ > or approx. 450 GeV. An upper bound on $M_{1/2}$ of approximately 1250 GeV is obtained from cosmological considerations. This enables us to provide both lower and upper bounds on the sparticle masses of the MSSM. For 130 GeV < or approx. $m_t(m_t)$ < or approx. 160 GeV, the lightest supersymmetric particle, essentially the bino, lies in the range 200 GeV < or approx. m_{LSP} < or approx. 550 GeV. The heaviest sparticles include the gluino (1 TeV < or approx. m_g < or approx. 3.0 TeV) and the squarks of the first two families which typically are about 10-20% heavier. (author). 16 refs, 4 figs.

4569 (IC–92/237) **Covariant Bethe-Salpeter wave functions for heavy hadrons.** Hussain, F. International Centre for Theoretical Physics, Trieste (Italy). Sep 1992. 8p. Order Number DE93608377. Source: OSTI; NTIS (US Sales Only); INIS.

In recent years the dynamics of heavy mesons and baryons has considerably simplified by the development of the so-called heavy quark effective theory (HQET). A covariant formulation of heavy meson and heavy baryon decays in the leading order of the HQET is presented. The method is based on a Bethe-Salpeter formulation in the limit of the heavy quark mass going to infinity. 15 refs, 4 figs.

4570 (IHEP-OTF–90-191) **State mixing in relativistic theory and properties of the third state in the system of pseudoscalar η-η'-η"(?)-mesons.** Nekrasov, M.L. Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Serpukhov (Russian Federation). Inst. Fiziki Vysokikh Ehnergij. 1990. 35p. Order Number DE93608375. Source: OSTI; NTIS (US Sales Only); INIS.

Submitted to Zeitschrift fuer Physik C.

Effect of mixing in systems of singlet pseudoscalar mesons described by the method of compound interpolating fields of the theoretical-field approach was studied. Decays of light pseudoscalar mesons $n \to \gamma\gamma$, $J/\Psi \to \rho n$, $J/\Psi \to \omega n$, $J/\Psi \to \gamma n$ decays, where $n = \eta, \eta', \eta$" are described, the widths of the decays, values of the ratio of η"- and η'-meson yield cross sections in charge-exchange $\Pi p \to \eta$"N reactions, as well as probabilities of $J/\Psi \to \gamma\eta$" decay, being evaluated. 25 refs.; 1 fig.; 4 tabs.

4571 (ITF–91-34) **Three-neutrino oscillations in matter and topological phases.** Naumov, V.A. AN Ukrainskoj SSR, Kiev (Ukraine). Inst. Teoreticheskoj Fiziki. 1991. 24p. (In Russian). Order Number DE93608386. Source: OSTI; NTIS (US Sales Only); INIS.

Implicit formulae for topological phases γ_N for system of three mixed Dirac neutrinos, propagating through the matter with arbitrary density and composition distributions, which are not dependent on the parametrization of vacuum mixing matrix V, are derived in the framework of Berry adiabatic approach. It is shown that Berry phases $\gamma_N{}^B$, originating under periodical varying matter parameters, are equal to zero identically, while γ_N not ident to 0 (at special gauge) for non-cyclic evolution under condition that the all matrix elements of V, CP-violating phase and neutrino mass squares differences $m_i{}^2 - m_j{}^2$ ($i \neq j$) are not equal zero simultaneously. Exact formulae for neutrino mixing matrix in the matter and adiabatic evolution operator are found. The recurrent algorithm for calculation of corrections to adiabatic approximation is given. 31 refs. (author).

4572 (LA–12380-T) **Part 1, Angular distribution measurement of beam-foil muonium, Part 2, Muon injection simulation for a new muon g-2 experiment.** Ahn, H.E. Los Alamos National Lab., NM (United States). Oct 1992. 290p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. Order Number DE93002178. Source: OSTI; NTIS; INIS; GPO Dep.

Thesis. Submitted to Yale Univ., New Haven, CT.

The angular and energy distributions of positive muons μ^+ and muonium M produced by the beam-foil method have been measured for the first time. A 7 MeV/c subsurface μ^+ beam was delivered to our apparatus from the Stopped Muon Channel at the Los Alamos Clinton P. Anderson Meson Physics Facility (LAMPF). The μ^+ formed M by electron capture in a thin Al target foil. A low pressure multi-wire proportional chamber upstream of the target foil was used both as a moderator and as a muon counter. To observe muonium, muons sere swept away by a bending magnet which was placed downstream of the target foil. This magnet was turned off while measuring the μ^+ distribution. Beyond the magnetic field, particles were collimated and then stopped by a microchannel plate detector located at various angles to the incident muon beam axis. Two pairs of scintillators mounted above (St) and below (Sb) the MC-P were used to detect the decay positrons to verify from the lifetime spectrum that the particles detected by the MCP are muons. The intensities of μ^+ and M emerging from the Al foil at different angles were obtained from both a time-of-flight spectrum and a lifetime spectrum.

4573 (LBL–32485) **Precise predictions for neutrino masses and mixings.** Hall, L.J. Lawrence Berkeley Lab., CA (United States). Aug 1992. 7p. Sponsored by USDOE, Washington, DC (United States); National Science Foundation, Washington, DC (United States). DOE Contract AC03-76SF00098. Grant PHY90-21139. (CONF-9206227–3: 15. international conference on neutrino physics, Granada (Spain), 7-13 Jun 1992; UCB-PTH–92/22). Order Number DE93002560. Source: OSTI; NTIS; INIS; GPO Dep.

This report discusses the motivation and the results of predictions of neutrino masses and coupling constants.

4574 (RAL–92-039) **Neutrino masses beyond the Standard Model.** Ranfone, S. Rutherford Appleton Lab., Chilton (United Kingdom). Jun 1992. 31p. Order Number DE93608387. Source: OSTI; NTIS (US Sales Only); INIS.

Commentary and transparencies of talk given at the Rutherford Appleton Laboratory, 27 May and 3 June 1992.

We give a brief review of some aspects of the physics of massive neutrinos. In the first part, in addition to the main phenomenological consequences of lepton mixing, are shown some of the principal models of neutrino masses based on $SU(2)_L xU(1)$, in the context of left-right symmetric models, and in the "standard" Grand Universal Theories (GUTs) (SU(5), SO(10)). In the second part, we review the lepton sector in the framework of a particular Universal Seesaw Model which may also include the 17 keV neutrino. In the last part, some recent results obtained in the context of the "flipped" SU(5)xU(1) and the SU(4)xO(4) Superstring Inspired GUT models are discussed. (author).

4575 (SLAC-PUB–5977) **New measurements of the τ lepton mass.** Marsiske, H. Stanford Linear Accelerator Center, Menlo Park, CA (United States). Oct 1992. 12p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC03-76SF00515. (CONF-9209270–1: 2. workshop on tau lepton physics, Columbus, OH (United States), 8-11 Sep 1992). Order Number DE93004021. Source: OSTI; NTIS; INIS; GPO Dep.

We report on recent measurements of the mass of the τ lepton, performed by the ARGUS, BES and CLEO experiments.

4576 (UCRL-LR–110897) **Measurements of the electric and magnetic form factors of the neutron and their dependence on inelastic modeling.** Stuart, L.M. Lawrence Livermore National Lab., CA (United States). Jun 1992. 250p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. Order Number DE93001625. Source: OSTI; NTIS; INIS; GPO Dep.

Thesis submitted to University of California, Davis.

The charge and magnetic elastic form factors of the neutron, $G_{En}(Q^2)$ and $G_{Mn}(Q^2)$, have been measured in the four-momentum transfer range $1.75 < Q^2 < 4.00$ (GeV/c)^2 using a Rosenbluth separation. These measurements constitute part of performed at the End Station A experiment NE11 which was facilities at the Stanford Linear Accelerator Center in the winter of 1989. The results show that $G_{Mn}(Q^2)/\mu_n$, $G_D(Q_2)$ is consistent with unity, where μ_n, is the neutron anomalous magnetic moment, and $G_D(Q^2) = (1.0 + Q^2/0.71)^{-2}$, is the empirical dipole formula. The results for $(G_{En}(Q^2)/G_D(Q^2))$ are consistent with zero within errors. The extraction of the neutron electromagnetic form factors from deuterium cross sections is a model dependent procedure because of the

Fermi momentum of the bound nucleons. In addition to the smeared quasielastic cross section, there is an inelastic tail due to pion production which extends into the quasielastic region. This tail is significant and must be subtracted to measure the neutron form factors. An extensive study has been made on the effect of the modeling of this tail on the measured form factors using different Fermi smearing models, off-mass-shell corrections, and deuteron wave functions. The off-mass-shell-effects were the largest, but still smaller than the experimental error. Comparisons were made with many theoretical models. Measurements were also obtained of the $\Delta(1232)$ resonance transition form factors in the range $1.6 < Q^2 < 6.75$ $(GeV/c)^2$.

6630 Nuclear Physics

4577 (BNL–47935) **Effective charges, the valence p-n interaction, and the IBM.** Casten, R.F. (Brookhaven National Lab., Upton, NY (United States)); Wolf, A. Brookhaven National Lab., Upton, NY (United States). [1992]. 7p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC02-76CH00016. (CONF-9208168–1: 7. symmetries in science: spectrum generating algebras and dynamic symmetries in physics, Nakajo (Japan), 28-31 Aug 1992). Order Number DE93001436. Source: OSTI; NTIS; INIS; GPO Dep.

There are three recent themes in nuclear structure that come together in an interesting and useful way via the concept of effective charges and the framework of the IBM. These three concepts are the importance of dynamical symmetries in describing nuclear structure and the benefits that accrue from their exploitation, secondly, the critical role of the p-n interaction in the onset and development of collectivity in nuclei, and, thirdly, the importance of the valence nucleons in determining structure and its evolution. We will illustrate this by showing that the interpretation of measured B(E2) values in the context of the dynamical symmetries of the IBM leads to new insights into the meaning of effective charges and offers new avenues to understand the role of the proton-neutron (p-n) interaction in modulating the nature of the valence space and the growth of collectivity. In particular, we will show that effective charges in valence models, such as the IBM, can be interpreted in terms of derivatives of the collectivity of the low lying levels, that is, as measures of the rate of change of collectivity as the proton and neutron numbers vary. This paper is based on recent work by the authors.

4578 (DOE/ER/40365–6) **Theoretical studies in medium-energy nuclear and hadronic physics.** Horowitz, C.J.; Macfarlane, M.H.; Matsui, T.; Serot, B.D. Indiana Univ., Bloomington, IN (United States). [1993]. 85p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG02-87ER40365. Order Number DE93004373. Source: OSTI; NTIS; INIS; GPO Dep.

A proposal for theoretical nuclear physics research is made for the period April 1, 1993 through March 31, 1996. Research is proposed in the following areas: relativistic many-body theory of nuclei and nuclear matter, quasifree electroweak scattering and strange quarks in nuclei, dynamical effects in (e,e′p) scattering at large momentum transfer, investigating the nucleon's parton sea with polarized leptoproduction, physics of ultrarelativistic nucleus–nucleus collisions, QCD sum rules and hadronic properties, non-relativistic models of nuclear reactions, and spin and color correlations in a quark-exchange model of nuclear matter. Highlights of recent research, vitae of principal investigators, and lists of publications and invited talks are also given. Recent research dealt primarily with medium-energy nuclear physics, relativistic theories of nuclei and the nuclear response, the nuclear equation of state under extreme conditions, the dynamics of the quark–gluon plasma in relativistic heavy-ion collisions, and theories of the nucleon–nucleon force.

6631 Nuclear Structure

Refer also to citation(s) 4597, 4617

4579 (BNL–47889) **Low lying electric dipole excitations in nuclei of the rare earth region.** von Brentano, P. (Koeln Univ. (Germany). Inst. fuer Kernphysik); Zilges, A.; Herzberg, R.D.; Zamfir, N.V.; Kneissl, U.; Heil, R.D.; Pitz, H.H.; Wesselborg, C. Brookhaven National Lab., Upton, NY (United States). [1992]. 21p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC02-76CH00016. (CONF-920555–3: 4. international spring seminar on nuclear physics: the building blocks of nuclear structure, Amalfi (Italy), 18-22 May 1992). Order Number DE93001441. Source: OSTI; NTIS; INIS; GPO Dep.

From many experiments with low energy photon scattering on deformed rare earth nuclei we have obtained detailed information about the distribution of electric dipole strength below 4 MeV. Apart from some weaker transitions between 2 and 4 MeV we observed one, and sometimes two, very strong El-groundstate transitions around 1.5 MeV in all examined nuclei. They arise from the de-excitation of the bandheads of the $(J^{\pi},K)=(1^-,0)$ and $(J^{\pi},K)=(1^-,1)$ octupole vibrational bands. It is shown that the decay branching ratios and the absolute transition strengths of these states can be reproduced rather well with an improved T(El)-operator in the sdf-Interacting Boson Model. Another class of octupole states has been investigated in the region of the semimagic nucleus ^{142}Nd. Here a quintuplet of collective excitations around 3.5 MeV is expected due to the coupling of the 3^--octupole vibration with the 2^+-quadrupole vibration. We performed photon scattering experiments on the odd A neighboring nucleus ^{141}Pr and found first evidence for the existence of $3^-\otimes 2^+\otimes$particle-states.

4580 (CONF-920113–9) **Memory effects in damping of collective vibrations.** Ayik, S. (Tennessee Technological Univ., Cookeville, TN (United States)); Boilley, D. Oak Ridge National Lab., TN (United States). [1992]. 9p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400 ;FG05-89ER40530. From 8. winter workshop on nuclear dynamics; Jackson Hole, WY (United States); 18-25 Jan 1992. Order Number DE93002359. Source: OSTI; NTIS; INIS; GPO Dep.

In this work we calculate the spreading width of collective vibrations due to collisional damping in the basis of a semi-classical transport equation with a memory dependent collision term. We obtain a simple analytical expression which provides a reasonable description for the observed damping widths of isoscalar and isovector giant resonances in medium mass and heavy nuclei at zero temperature, as well as at finite temperatures.

4581 (CONF-9205108–17) **New vistas in superdeformation.** Nazarewicz, W. (Joint Inst. for Heavy Ion Research, Oak Ridge, TN (United States)). Oak Ridge National Lab., TN (United States). [1992]. 11p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400 ;FG05-87ER40361. From International conference on nuclear structure at high angular momentum; Ottawa (Canada); 18-21 May 1992. Order Number DE93001706. Source: OSTI; NTIS; INIS; GPO Dep.

An aerial radiological survey was conducted from July 11–20, 1990, over an 83-square-kilometer (32-square-mile) area surrounding the Portsmouth Gaseous Diffusion Plant located near Portsmouth, Ohio. The survey was conducted at a nominal altitude of 91 meters (300 feet) with line spacings of 122 meters (400 feet). A contour map of the terrestrial gamma exposure rate extrapolated to 1 meter above ground level (AGL) was prepared and overlaid on an aerial photograph and a set of United States Geological Survey (USGS) topographic maps of the area. The terrestrial exposure rates varied from about 7 to 14 microroentgens per hour (μR/h) at 1 meter above the ground. Analysis of the data for man-made sources and for the uranium decay product, protactinium-234m (^{234m}Pa), showed five sites within the boundaries of the Portsmouth Gaseous Diffusion Plant with elevated readings. Spectra obtained in the vicinity of the buildings at the Portsmouth Gaseous Diffusion Plant showed the presence of ^{234m}Pa, a uranium-238 (^{238}U) decay product. In addition, spectral analysis of the data obtained over the processing plant facility showed gamma activity indicative of uranium-235 (^{234}U). No other man-made gamma ray emitting radioactive material was detected, either on or off the Portsmouth Gaseous Diffusion Plant property. Soil samples and pressurized ion chamber measurements were obtained at five different locations within the survey boundaries to support the aerial data.

4582 (CTA-IEAV-RI–007/83) **Parastatistics as a nuclear structure effective description.** Mastroleo, R.C. Centro Tecnico Aeroespacial (CTA-IEAv), Sao Jose dos Campos, SP (Brazil). Inst.

de Estudos Avancados. 9 Dec 1983. 16p. (In Portuguese). Order Number DE93608409. Source: OSTI; NTIS (US Sales Only); INIS.

This work describes the parastatistics when used to describe the nuclear structure. It is able to describe very well, all the effects originating from the internal structure of complex systems. (A.C.A.S.).

4583 (DOE/ER/40330–64) **Nuclear structure from radioactive decay: Annual progress report.** Wood, J.L. Georgia Inst. of Tech., Atlanta, GA (United States). School of Physics. 30 Sep 1992. 25p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG05-87ER40330. Order Number DE93002795. Source: OSTI; NTIS; INIS; GPO Dep.

The most important aspect of the wind-up of UNISOR-based research is completion of student theses. Analysis is proceeding on extensive studies in the neutron-deficient rare earth isotopes with $N < 82$ and the neutron-deficient region below $Z = 82$. These studies address the onset of deformation in the $N < 82$, $Z > 50$ open shell region and shape coexistence in the $N \sim 104$, $Z \leq 82$ region, respectively. The main ongoing topics are shape coexistence in nuclei and the microscopic structure of collective motion in nuclei from a phenomenological point of view. New topics this year focus on the structure of nuclei near the $N = Z$ line. Two topics have been chosen for detailed study: shape coexistence and electric monopole transition strengths.

4584 (DOE/ER/40418–5) **Nuclear structure studies: Progress report.** Walters, W.B. Maryland Univ., College Park, MD (United States). Dept. of Chemistry. 31 Aug 1992. 18p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG05-88ER40418. Order Number DE93002791. Source: OSTI; NTIS; INIS; GPO Dep.

New results are reported for the decay and nuclear orientation of ^{114,116}I and ^{114}Sb as well as data for the structure of daughter nuclides ^{114,116}Te. New results for IBM-2 calculations for the structure of ^{126}Xe are also reported. A new approach to the problem of the underproduction of $A = 120$ nuclides in the astrophysical r-process is reported.

4585 (GSI–92-18(prepr.)) **Relativistic Fock diagrams at finite density.** Henning, P.A. (Technische Hochschule Darmstadt (Germany). Inst. fuer Kernphysik). Gesellschaft fuer Schwerionenforschung mbH, Darmstadt (Germany). Mar 1992. 32p. Order Number DE93728962. Source: OSTI; NTIS (US Sales Only); INIS.

Within a simple relativistic field theory coupling scalar mesons and nucleons, analytical expressions are derived for the Fock self energy amplitudes at finite baryon density. The strong coupling required to model nuclear matter turns out to be near a critical value, beyond which a perturbation expansion in such system breaks down. This has the effect of shifting the Landau ghost poles of the perturbative propagator to rather low energies. The removal of these unphysical poles can be achieved either at the level of propagators or at the level of self energy amplitudes. In the latter case, the removal of the ghost poles is shown to have a big effect on the self energies because of the coupling strength. (orig.).

4586 (IFT-P–010/92) **Three-body collapse for Tabakin potentials and the Thomas effect.** Delfino, A. (Universidade Federal Fluminense, Niteroi, RJ (Brazil). Dept. de Fisica); Adhikari, S.K.; Tomio, L. Instituto de Fisica Teorica (IFT), Sao Paulo, SP (Brazil). Mar 1992. 18p. Order Number DE93608412. Source: OSTI; NTIS (US Sales Only); INIS.

A system constituted of three bosons interacting via two-body separable potentials with fixed two-boson binding is known to lead to bound state collapse in the case where the potential parameters allow two-boson S matrix poles close to (resonance) and on (continuum bound state) the real momentum axis. The collapse is shown to be accompanied by an increase in the average kinetic energy of the two-body bound state, which signals a decrease in the range of the two-body interaction for fixed two-body binding. The collapse is claimed to be a manifestation of the well-known Thomas effect which leads to a collapse of the three-body system when the range of the two-body interaction goes to zero for a fixed two-body binding. (author).

4587 (INDC(CUB)–006/G) **Combined method of deformed nuclei level density calculation code (DENCOM).** Egorov, S.A. (Radievyj Inst., Leningrad (Russian Federation)); Rubchenya, V.A.; Garcia, V.F.; Rodirguez, H.O. International Atomic Energy Agency, Vienna (Austria). International Nuclear Data Committee. Mar 1992. 24p. Order Number DE93608413. Source: OSTI; NTIS (US Sales Only); INIS.

A computer code based on the semimicroscopical combined method of deformed nuclei level density calculation is described. It includes the use of combinatorial and statistical approaches for low and high energies correspondingly, both calculations are fulfilled in the frames of superfluid model. The employed models, the proceeding of the code, the required input data and the output are discussed. (author). 18 refs, 5 figs.

4588 (INDC(NDS)–250/G,ND) **Co-ordination of the international network of nuclear structure and decay data evaluation: Summary report of a consultants' meeting held at the Kuwait Institute for Scientific Research, Kuwait, 10-14 March 1990.** Lemmel, H.D. (ed.). International Atomic Energy Agency, Vienna (Austria). International Nuclear Data Committee. Nov 1991. 132p. (CONF-9003331–: IAEA consultants' meeting of the participants in the international network of nuclear structure and decay data evaluators, Kuwait (Kuwait), 10 Mar 1990). Order Number DE93608410. Source: OSTI; NTIS (US Sales Only); INIS.

The IAEA Nuclear Data Section convened the ninth meeting of the international nuclear structure and decay data network at Kuwait, 10-14 March 1990. The meeting was attended by 19 scientists from 9 Member States and two international organizations, concerned with the compilation, evaluation, and dissemination of nuclear structure and decay data. The document contains a summary and the proceedings of the meeting, and in annexes, status reports of activities in nuclear structure and decay data from the participating centers. A separate abstract was prepared for one of the scientific lectures related to the topics of the meeting which is reproduced in full length. Refs, figs and tabs.

4589 (INP–1543/PL) **Clustering of 1p-shell nuclei in the framework of the shell model.** Kwasniewicz, E. (Uniwersytet Slaski, Katowice (Poland). Inst. Fizyki). Institute of Nuclear Physics, Cracow (Poland). 1991. 54p. Contracts CPBP 01-09 and P/04/134/90-2. Order Number DE93608434. Source: OSTI; NTIS (US Sales Only); INIS.

The two- and three-fragment clustering of the 1p-shell nuclei has been studied in the framework of the shell model. The absolute probabilities of the required types of clustering in a given nucleus have been obtained by projecting its realistic shell-model wavefunction onto the suitable subspace of the orthonormal, completely antisymmetric two- or three-cluster states. With the aid of these data the selectivity in population of final states produced in multinucleon transfer reactions has been discussed. This problem has also been considered in the approach where the exchange of nucleons between clusters has been neglected. This has enabled to demonstrate the role of the complete antisymmetrization in predicting the intensities of states populated in multinucleon transfer reactions. The compact theory of the multinucleon one- and two-cluster spectroscopic amplitudes has been formulated. The examples of studying the nuclear structure and reactions with the aid of these spectroscopic amplitudes have been presented. (author).

4590 (KIYal–91-1) **One-nucleon integrals of overlap of wave functions of lightest nuclei.** Voloshin, N.I.; Levshin, E.B.; Fursa, A.D. AN Ukrainskoj SSR, Kiev (Ukraine). Inst. Yadernykh Issledovanij. 1991. 23p. (In Russian). Order Number DE93608435. Source: OSTI; NTIS (US Sales Only); INIS.

The integrals of overlap of wave functions of ^{4}He nucleus with wave functions of He and ^{3}He nuclei were calculated. To describe nucleus structure the model wave functions of two types were used. In one case the complete wave nucleus function was selected as a production of one-particle functions, presenting Gaussian superposition. In other case the multiparticle wave functions of nuclei were selected at once in translation-invariant form and it also had the Gaussian dependence. The parameters of nucleus wave functions were found using description conditions of the experimental values of charge radii and form-factors of nuclei up to $q^2 <= 30 fm^{-2}$. During the calculation the charge distribution in the proton and neutron was taken into account. 23 refs.; 8 figs.; 4 tabs. (author).

4591 (KIYal–91-4) **On stable nuclei mass charge distribution.** Lendel, A.I.; Marinets, T.I.; Sikora, D.I.; Charnovich, E.I.; Yankanich, M.M. AN Ukrainskoj SSR, Kiev (Ukraine). Inst. Yadernykh Issledovanij. 1991. 8p. (In Russian). Order Number DE93608414. Source: OSTI; NTIS (US Sales Only); INIS.

The charge distribution of mass averaged stable nuclei about trajectory that cross the points with proton and neutron numbers nearly magic is investigated. It is shown that the charge distribution of ΔM have a symmetric property on nucleus charge z=45 and mass number A=103. The distribution of ΔM is compared with charge distribution of product of ^{206}Th fission in framework of statistic model. 4 refs.; 1 fig. (author).

4592 (LA-UR–92-3189) **Nuclear masses and fission barriers for astrophysical applications.** Moeller, P. (Los Alamos National Lab., NM (United States)); Nix, J.R.; Kratz, K.L.; Woehr, A.; Thielemann, F.K. Los Alamos National Lab., NM (United States). [1992]. 21p. Sponsored by USDOE, Washington, DC (United States); Deutsche Forschungsgemeinschaft, Bonn (Germany). DOE Contract W-7405-ENG-36. (CONF-9209239–1: Workshop on nuclear physics in the universe, Oak Ridge, TN (United States), 24-26 Sep 1992). Order Number DE93000869. Source: OSTI; NTIS; GPO Dep.

We review the current status of the macroscopic-microscopic method for calculating nuclear masses, fission barriers and other nuclear-structure quantities of interest in astrophysical applications. We discuss what would be some minimal requirements of a nuclear mass model and study how the macroscopic-microscopic method and other nuclear mass models fullfil such basic requirements. Finally, we discuss some results of astrophysical calculations based on macroscopic-microscopic nuclear-structure models.

4593 (LUND-MPH–92-01) **Interaction strength of two crossing bands.** Hagemann, G.B. (Niels Bohr Inst., Copenhagen (Denmark)); Hamamoto, Ikuko. Lund Univ. (Sweden). Dept. of Mathematical Physics. Apr 1992. 19p. Order Number DE93608436. Source: OSTI; NTIS; INIS.

The interaction strengths of the ground band with the S-band are extracted by using observed states of both bands as well as observed relative E2 transition rates for γ-decay to yrast and non-yrast states. The signature dependence of the strength observed in the negative-parity yrast sequences of ^{157}Ho is explained, first when a relatively strong n-p Q" x Q" interaction is introduced in the conventional axially-symmetric particle-rotor model. The Q" x Q" interaction is supposed to take care of the possible shape-driving effect due to the presence of aligned quasiparticles. (au).

4594 (SINS–2111/P-8/PL/B) **Collective properties of octupole-deformed atomic nuclei.** Boening, K. Soltan Inst. for Nuclear Studies, Otwock-Swierk (Poland). Mar 1991. 76p. (In Polish). Order Number DE93608415. Source: OSTI; NTIS (US Sales Only); INIS.

Report received in March 1992.

Collective properties of even-even nuclei in the radium region are studied theoretically. Energy of the lowest collective states and reduced probabilities B(E2) and B(E3) of electromagnetic transitions between these states are mainly analysed. The excited states are treated as large-amplitude quadrupole and octupole vibrations coupled with each other. A large anharmonicity of the spectrum and a large value B(E3) of the transition from the first octupole excited state to the ground state are obtained, for octupole-deformed nuclei. A strong dependence of the results on the shape of the potential energy of a nucleus, treated as a function of its deformation, is stressed. (author).

4595 (UCRL-JC–109942) **Superdeformation in the A = 190 region: The lead nuclei.** Henry, E.A. (Lawrence Livermore National Lab., CA (United States)); Becker, J.A.; Brinkman, M.J.; Kuhnert, A.; Stoyer, M.A.; Wang, T.F.; Yates, S.W.; Azaiez, F.A.; Beausang, C.W.; Burde, J.; Deleplanque, M.A.; Diamond, R.M.; Draper, J.E.; Kelly, W.H.; KortLawrence Livermore National Lab., CA (United States). Jul 1992. 8p. Sponsored by USDOE, Washington, DC (United States); National Science Foundation, Washington, DC (United States). DOE Contract W-7405-ENG-48 ;AC03-76SF00098. (CONF-9205108–16: International conference on nuclear structure at high angular momentum, Ottawa (Canada), 18-21 May 1992). Order Number DE93001321. Source: OSTI; NTIS; INIS; GPO Dep.

Superdeformed (SD) bands have been identified in the four even-even lead nuclei ^{192}Pb, ^{194}Pb, ^{196}Pb, and ^{198}Pb. The discovery of SD bands in these nuclei extended the region of superdeformation in the A = 190 region to Z = 82, and to neutron numbers up to N = 116. All of the SD bands in these nudei are observed with transition energies ranging from about 250 key to about 600 keV, with the lowest energy SD band transition for the entire region of 169 keV in ^{194}Pb. The spins deduced for the lowest levels in the SD bands are (10,11), 6,8, and 12 for ^{192,194,196,198}Pb, respectively. The dynamic moments of inertia of ^{192}Pb and ^{194}Pb are similar to each other, and to those of many other SD bands in this mass region. The dynamic moments of inertia of ^{196}Pb and ^{198}Pb are somewhat lower than those of ^{192,194}Pb at a given frequency. The experimental lifetimes in ^{194}Pb and the deduced transition quadrupole moments are equal to those of other nudei in the region within errors. While SD bands have been observed in the odd-neutron Hg and Tl nuclei, SD bands have not been reported for the odd-neutron Pb nuclei. In this contribution we discuss briefly three topics on superdeformation in the lead nuclei. First, we have recent experimental data on ^{196}Pb that extends our knowledge of the SD band in that nucleus. Next we review briefly the population of low-lying yrast levels from the decay of the SD bands in ^{192,194,1296}Pb. Finally, we summarize our efforts to identify superdeformation in the odd-A Pb nuclei. All of the experiments described here were performed using the HERA spectrometer at the 88-Inch Cyclotron facility located at Lawrence Berkeley Laboratory.

6632 Radioactivity and Electromagnetic Transitions (Excluding Fission)

Refer also to citation(s) 4584, 4588, 4623

4596 (CONF-9210192–1) **Lifetimes in ^{15}N from gamma-ray line shapes produced in the ^{14}N(thermal n,γ) reaction.** Raman, S. (Oak Ridge National Lab., TN (United States)); Jurney, E.T.; Starner, J.W.; Kuronen, A.; Keinonen, J. Oak Ridge National Lab., TN (United States). [1992]. 12p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. From Workshop on applications of high resolution gamma spectroscopy in studies of atomic collisions and nuclear lifetimes; Grenoble (France); 5-7 Oct 1992. Order Number DE93001709. Source: OSTI; NTIS; INIS; GPO Dep.

Mean lifetimes of bound levels in ^{15}N were inferred from the primary γ-ray-induced Doppler broadening (GRID) of secondary γ rays in the thermal-neutron capture reaction ^{14}N(n,γ). GRID measurements were made with melamine ($C_3H_6N_6$) as both target and slowing-down medium. The Doppler-broadened γ-ray line shapes were analyzed by molecular dynamics simulations of the slowing-down process to obtain the lifetime values for four states in ^{15}N. Preliminary results will be shown.

4597 (INDC(NDS)–250/G,ND, pp. 132) **Signature dependence of M1 and E2 transition probabilities for the $i_{13/2}$ and $f_{7/2}$ rotational band in ^{161}Dy, ^{163}Dy, ^{167}Er and ^{173}Yb studied by heavy-ion Coulomb excitation: Annex 17.** Hashizume, A. (Institute of Physical and Chemical Research, Wako, Saitama (Japan)). International Atomic Energy Agency, Vienna (Austria). International Nuclear Data Committee. Nov 1991. (CONF-9003331–: IAEA consultants' meeting of the participants in the international network of nuclear structure and decay data evaluators, Kuwait (Kuwait), 10 Mar 1990). In *Co-ordination of the international network of nuclear structure and decay data evaluation: Summary report of a consultants' meeting held at the Kuwait Institute for Scientific Research, Kuwait, 10-14 March 1990.* vp. Order Number DE93608410. Source: OSTI; NTIS (US Sales Only); INIS.

The ground-state rotational bands in ^{161}Dy, ^{163}Dy and ^{173}Yb have been investigated through multiple Coulomb excitation with a beam of 250 MeV ^{58}Ni and in ^{167}Er with a beam of 160 MeV ^{35}Cl. 18 new levels were identified and 36 lifetimes were measured for the first time by a Doppler shift attenuation method and for a recoil distance method. 86 reduced transition probabilities of B(M1) or

B(E2) were obtained between the states in these nuclei. 14 refs, 15 figs, 2 tabs.

4598 (INIS-mf–13375, pp. 23) **Investigation of γ-transitions in the $^{140}Ce(n,n'\gamma)$ reaction.** Rateb, G.M.; Cherepantsev, Y.K.; Demidov, A.M.; Araddad, S.Y. Tajoura Nuclear Research Centre, Tripoli (Libyan Arab Jamahiriya). 1984. 82p. (CONF-8409421–: Seminar on the use of research reactors in fundamental and applied sciences, Tajoura (Libyan Arab Jamahiriya), 16 Sep 1984). In *Seminar on the use of research reactors in fundamental and applied sciences. Programme and abstracts.* Order Number DE93606515. Source: Also available from Tajoura Nuclear Research Centre, Tajoura/Tripoli, Libya.

Short communication. CERIUM 140 TARGET/multipole transitions; CERIUM 140 TARGET/neutron reactions; ANGULAR DISTRIBUTION; GAMMA SPECTRA; SPIN ORIENTATION

4599 (SINS–2093/P-8/PH/B) **Stability of the heaviest atomic nuclei.** Patyk, Z. Soltan Inst. for Nuclear Studies, Otwock-Swierk (Poland). Jul 1990. 57p. (In Polish). Order Number DE93608441. Source: OSTI; NTIS (US Sales Only); INIS.

Calculations of the alpha-decay and the spontaneous-fission of the heaviest nuclei are described. Main attention is given to the presentation of the results of the author, obtained in recent few years. One of the important modification, with respect to earlier studies, is the use of a multidimensional deformation space, which is especially important for the calculation of the fission barrier. Even-even nuclei with atomic number Z=92-110 are considered. Much attention is paid to the description of shell effects in the half-lives. These effects are especially important for the heaviest nuclei as they decide the question of their existence. (author).

6633 Nuclear Reactions and Scattering, General

Refer also to citation(s) 3751, 4621, 4627

4600 (CBPF-NF–040/91) **Tetrahedral percolation model and energy spectra of nuclear fragmentation.** Santiago, A.J.; Chung, K.C. Centro Brasileiro de Pesquisas Fisicas (CBPF), Rio de Janeiro, RJ (Brazil). 1991. 10p. Order Number DE93608449. Source: OSTI; NTIS (US Sales Only); INIS.

A Monte Carlo simulation based on the so-called tetrahedral percolation model is shown to reproduce very satisfactorily the experimental data from high-energy proton-induced reactions. This suggests that the main features of nuclear fragmentation may be understood by geometric and probabilistic considerations only. (author).

4601 (GSI–92-39(prepr.)) **Isotopic effects in the disassembly of hot nuclear systems.** Lozhkin, O.V. (V.G. Khlopin Radium Inst., St. Petersburg (Russia)); Trautmann, W. Gesellschaft fuer Schwerionenforschung mbH, Darmstadt (Germany). Jun 1992. 30p. Order Number DE93728817. Source: OSTI; NTIS (US Sales Only); INIS.

The analysis of isotopic effects in the production of intermediate mass fragments from light-ion induced reactions on heavy nuclei reveals a high degree of equilibration in the isotopic degree of freedom. The observed effects are quantitatively reproduced by the quantum statistical model based on chemical equilibrium. The nearly identical isotopic yield ratios for reactions induced by light ions (p, d, α) of several GeV and by heavy ions (^{12}C, ^{14}N, ^{18}O) of 30-100 MeV/u suggest that the statistical parameters of the hot nuclear systems produced in both types of reactions are very similar. (orig.).

4602 (IFT-P–015/92) **Model independence of scattering of three identical bosons in two dimensions.** Adhikari, S.K. (Instituto de Fisica Teorica (IFT), Sao Paulo, SP (Brazil)); Tomio, L.; Delfino, A.; Frederico, T. Instituto de Fisica Teorica (IFT), Sao Paulo, SP (Brazil). May 1992. 26p. Order Number DE93608450. Source: OSTI; NTIS (US Sales Only); INIS.

Within the framework of scattering integral equations in momentum space we present numerical results of scattering of three-identical bosons at low energies in two dimensions for short-range separable potentials. An analysis of the present numerical results reveal the three-particle scattering observables to be independent of potential shape provided the low-energy two-particle binding energy and scattering length are held fixed throughout the investigation. (author).

4603 (INIS-BR–3030) **Elastic scattering of gamma radiation in solids.** Goncalves, O.D. Universidade Federal, Rio de Janeiro, RJ (Brazil). Inst. de Fisica. 1987 139p. (In Portuguese). Order Number DE93608451. Source: OSTI; NTIS (US Sales Only); INIS.

The elastic scattering of gamma rays in solids is studied: Rayleigh scattering as well as Bragg scattering in Laue geometries. We measured Rayleigh cross sections for U, Pb, Pt, W, Sn, Ag, Mo, Cd, Zn, and Cu with gamma energies ranging from 60 to 660 KeV and angles between 5^0 and 140^0. The experimental data are compared with form factor theories and second order perturbation theories and the limits of validity of both are established. In the 60 KeV experiment, a competition between Rayleigh and Bragg effects is found in the region of low momentum transfer. The Bragg experiments were performed using the gamma ray diffractometer from the Hahn-Meitner Institut (Berlin) with gammas of 317 KeV and angles up to 2^0. In particular, we studied the effect of annealing in nearly perfect Czochralski Silicon crystals with high perfection in the crystallographic structure. The results are compared with Kinematical and Dynamical theories. (author).

4604 (NEANDC(E)–332-U-Vol.3-EURATOM) **Annual progress report on nuclear data, 1991.** Hansen, H.H. (ed.). Commission of the European Communities, Geel (Belgium). Central Bureau for Nuclear Measurements. May 1992. 43p. Sponsored by Commission of the European Communities, Brussels (Belgium). (INDC(EUR)–026/G;EUR–14514). Order Number DE93003137. Source: OSTI; NTIS (US Sales Only).

This report discusses the following topics: Nuclear Data for Standards; Nuclear Data for Fission Technology; Nuclear Data for Fusion Technology; and Nuclear Metrology.

4605 (WHC-SA–1430) **MOCAL, a Monte Carlo albedo code.** Morford, R.J.; Carter, L.L.; Siciliano, E.R. Westinghouse Hanford Co., Richland, WA (United States). Jan 1992. 9p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-87RL10930. (CONF-920431–29: Meeting on new horizons in radiation protection and shielding, Pasco, WA (United States), 26 Apr - 1 may 1992). Order Number DE93002049. Source: OSTI; NTIS; GPO Dep.

The MOCAL code is a Monte Carlo code that uses pre-existing albedo data files to determine neutron penetrations into shielding air gaps. By using the albedos along the bounding surfaces of the gaps, expensive computational tracking of neutrons through material regions is eliminated. Thus, the run-time for MOCAL is relatively short, compared to conventional Monte Carlo methods of tracking neutrons completely through the materials. Also as a result of this albedo treatment, MOCAL is very easy to use, with the time required to prepare a typical input data file to be less than 15 minutes in most cases.

6634 Specific Nuclear Reactions and Scattering

Refer also to citation(s) 4039, 4526, 4527, 4543, 4544, 4596, 4598, 4599, 4601, 4722, 4723, 4738, 4739, 4795

4606 (ANL/NDM–125) **Fast neutron scattering near shell closures: Scandium.** Smith, A.B.; Guenther, P.T. Argonne National Lab., IL (United States). Aug 1992. 38p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-31109-ENG-38. Order Number DE93002090. Source: OSTI; NTIS; INIS; GPO Dep.

Neutron differential elastic- and inelastic-scattering cross sections are measured from $\approx$ 1.5 to 10 MeV with sufficient detail to define the energy-averaged behavior of the scattering processes. Neutrons corresponding to excitations of 465 $\pm$ 23, 737 $\pm$ 20, 1017 $\pm$ 34, 1251 $\pm$ 20, 1432 $\pm$ 23 and 1692 $\pm$ 25 keV are observed. It is shown that the observables, including the absorption cross section, are reasonably described with a conventional optical-statistical model having energy-dependent geometric parameters. These energy dependencies are alleviated when the

model is extended to include the contributions of the dispersion relationship. The model parameters are conventional, with no indication of anomalous behavior of the neutron interaction with ^{45}Sc, five nucleons from the doubly closed shell at ^{40}Ca.

4607 (CBPF-NF–032/91) **Fluctuation effects on bubble growth in hot nuclear matter.** Santiago, A.J.; Chung, K.C. Centro Brasileiro de Pesquisas Fisicas (CBPF), Rio de Janeiro, RJ (Brazil). 1991. 15p. Order Number DE93608479. Source: OSTI; NTIS (US Sales Only); INIS.

The evolution of bubbles with arbitrary density in an infinite nuclear system is studied in a simplified treatment. Kinetic pressure fluctuations on the bubble surface are considered. The critical radius, evolution time and probability for bubble expansion are shown to depend significantly on the initial bubble density. (author).

4608 (CONF-921046–4) **Equilibrium and pre-equilibrium models for calculation of particle emission cross sections and spectra.** Fu, C.Y. Oak Ridge National Lab., TN (United States). [1992]. 10p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. From Symposium on nuclear data evaluation methodology; Upton, NY (United States); 12-16 Oct 1992. Order Number DE93001635. Source: OSTI; NTIS; INIS; GPO Dep.

Improvements of equilibrium and pre-equilibrium models that have been applied to the evaluations of the recently released nuclear data libraries are reviewed. The improvements include energy-angle correlated neutron emission in the continuum, charged-particle and recoil spectra, widths-fluctuation correction for the continuum, pre-equilibrium capture, and gamma-ray strength functions. Their impacts on evaluated data are summarized.

4609 (DOE/ER/40246–7) **Neutrons scattering studies in the actinide region: Progress report, August 1, 1991–July 31, 1992.** Kegel, G.H.R.; Egan, J.J. Lowell Univ., MA (United States). Radiation Lab. Sep 1992. 21p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG02-86ER40246. Order Number DE93003655. Source: OSTI; NTIS; INIS; GPO Dep.

During the report period were investigated the following areas: prompt fission neutron energy spectra measurements; neutron elastic and inelastic scattering from ^{239}Pu; neutron scattering in ^{181}Ta and ^{197}Au; response of a ^{235}U fission chamber near reaction thresholds; two-parameter data acquisition system; "black" neutron detector; investigation of neutron-induced defects in silicon dioxide; and multiple scattering corrections. Four Ph.D. dissertations and one M.S. thesis were completed during the report period. Publications consisted of three journal articles, four conference papers in proceedings, and eleven abstracts of presentations at scientific meetings. There are currently four Ph.D. and one M.S. candidates working on dissertations directly associated with the project. In addition, three other Ph.D. candidates are working on dissertations involving other aspects of neutron physics in this laboratory.

4610 (DOE/ER/40343–6) **Investigation of pion-nucleus interactions: Progress report, April 1, 1991–March 31, 1992.** Moore, C.F. Texas Univ., Austin, TX (United States). Dept. of Physics. Sep 1992. 31p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG05-87ER40343. Order Number DE93004375. Source: OSTI; NTIS; INIS; GPO Dep.

This report summarizes the work carried out by personnel from the University of Texas at Austin at the Los Alamos Clinton P. Anderson Meson Physics Facility (LAMPF). The research activities involved experiments done with the Energetic Pion Channel and Spectrometer (EPICS), the Low Energy Pion Channel (LEP), the Pion and Particle Physics Channel (P^3), the High Resolution Spectrometer (HRS), and planning a new experimental program associated with the new high-resolution Neutral Meson Spectrometer (NMS) at LAMPF. A brief overview of work supported by this grant is given followed by an account of the study of the double giant resonances in pion double charge exchange on ^{51}V, ^{115}In, and ^{197}Au. This report contains a list of published papers and preprints, abstracts, and invited talks. These papers summarize experiments involving participants supported by this grant and indicate the work accomplished by these participants in this program of medium energy nuclear physics research. Lists of the most recent proposals on which we have participation at LAMPF, proposals which have been approved this past year to run as experiments, personnel who have participated in this research program are included. The research cited in this report is, in many cases, the collaborative effort of many groups associated with research at LAMPF.

4611 (DOE/ER/40405–5) **Nuclear structure studies at intermediate energy: Progress report, August 1991–August 1992.** Hintz, N.M.; Sethi, A.; Starodubsky, V.; Yang, Xin hua; Franey, M.; Mihaildis, D. Minnesota Univ., Minneapolis, MN (United States). School of Physics and Astronomy. Sep 1992. 108p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG02-88ER40405. Order Number DE93003661. Source: OSTI; NTIS; INIS; GPO Dep.

New experimental results are given for proton elastic and inelastic cross sections for $^{182,186}W$ at 650 MeV, ^{208}Pb and $^{60}Ni(p,t)$ cross sections at 120 MeV, a coincidence study of the $^{40}Ca(\vec{p},2p)$ reaction. In addition to the above, data reduction and analysis are also being carried out as follows: global analysis of ^{28}Si and $^{58}Ni(\vec{p},p')$ data at 135, 178, 333, 500, and 800 MeV for high-spin stretched states using medium modified interactions (conventional and QCD effective mass modifications); analysis of $^{206,207,208}Pb(\vec{p},p)$ elastic data at 650 MeV. Work on development of techniques to study relativistic effects of proton–nucleus scattering at forward angles and extended angular range of S_{nn} measurements in ^{40}Ca was also carried out.

4612 (ECN-RX–92-023) **Revision of JEF-2 evaluations for the long-lived fission products ^{129}I and ^{99}Tc: Presented at the NEA Specialist' Meeting on Fission Product Nuclear Data, JAERI, Japan, 25-27 May 1992.** Kamp, H.A.J. van der (Netherlands Energy Research Foundation (ECN), Petten (Netherlands)); Gruppelaar, H. Netherlands Energy Research Foundation (ECN), Petten (Netherlands). May 1992. 14p. (CONF-9205255–: NEA specialists meeting on fission product nuclear data, Tokyo (Japan), 25 May 1992). Order Number DE93608467. Source: OSTI; NTIS; INIS.

This paper describes revisions of the neutron radiative capture cross-sections of ^{129}I and ^{99}Tc for JEF-2.2. For ^{129}I the main revision was the modification of resonance parameters at negative energy to fit the most recent experimental values of thermal cross-section and resonance integral, measured by Friedmann et al. This leads to a large increase in the thermal cross-section from 27b to 33.9b and a slight increase in the resonance integral from 28.8b to 30.6b. The revision of ^{99}Tc consists of adopting the first two resonances from the work of Fischer, leading to a value of the resonance integral of about 300b, which is lower than the recommended value of the Brookhaven compilation. (author). 23 refs.; 2 figs.; 4 tabs.

4613 (GSI–92-17(prepr.)) **Statistical fragmentation of Au projectiles at E/A=600 MeV.** Hubele, J. (Gesellschaft fuer Schwerionenforschung mbH, Darmstadt (Germany)); Kreutz, P.; Lindenstruth, V.; Adloff, J.C.; Begemann-Blaich, M.; Kunde, G.J.; Liu, Z.; Lynen, U.; Meijer, R.J.; Milkau, U.; Mueller, W.F.J.; Ogilvie, C.A.; Pochodzalla, J.; Sann,Gesellschaft fuer Schwerionenforschung mbH, Darmstadt (Germany). Mar 1992. 17p. Order Number DE93728959. Source: OSTI; NTIS (US Sales Only); INIS.

The mean multiplicity of intermediate mass fragments (M_{IMF}) produced by fragmentation of Au projectiles interacting with targets of C, Al, Cu and Pb at an incident energy of E/A = 600 MeV is compared to predictions of statistical multifragmentation and sequential evaporation models. The initial conditions for the calculations were provided by BUU simulations. In the high excitation energy regime the observed universal correlation between (M_{IMF}) and the total charge Z_{bound} of projectile fragments with charges $Z \geq 2$ can not be reprocuced by the sequential evaporation code GEMINI. The data are well described by statistical decay calculations which assume the formation of an expanded nuclear system and a rather fast break-up. (orig.).

4614 (GSI–92-23(prepr.)) **Charge correlations as a probe of nuclear disassembly.** Kreutz, P. (Frankfurt Univ. (Germany). Inst. fuer Kernphysik); Pochodzalla, J.; Schuettauf, A.; Tucholski, A.; Adloff, J.C.; Rudolf, G.; Stuttge, L.; Bouissou, P.; Leray, S.;

Imme, G.; Raciti, G.; Iori, I.; Moroni, A. Gesellschaft fuer Schwerionenforschung mbH, Darmstadt (Germany). Mar 1992. 39p. Order Number DE93728958. Source: OSTI; NTIS (US Sales Only); INIS.

We have studied multi-fragment decays of Au projectiles after collision with C, Al, Cu and Pb targets at a bombarding energy of 600 MeV/nucleon. We examine the correlations between the charges emitted in these reactions. These correlations are given as a function of the total charge in bound fragments, Z_{bound}, at forward angles, which is a measure of the violence of the collision and can be related to the impact parameter. The charge distributions have been fit by a power law and the extracted τ parameter exhibits a minimum as a function of Z_{bound}. We observe a strong reduction in the maximum charge, Z_{max}, of the event with decreasing Z_{bound}. For those events where Z_{max} is less than half Z_{bound}, the relative sizes of the two largest charges within the event cover the full spectrum of possibilities. The charge-Dalitz plots indicate that the multi-fragmentation events are not an extension of symmetric fission reactions. The event-by-event charge moments are examined to measure the size of the charge fluctuations. All of the charge correlations are independent of the target when plotted as a function of Z_{bound}. The results are compared to both nuclear statistical and percolation calculations. The model predictions differ from each other, establishing that the observables are sensitive to how the available phase space is populated. The sequential nuclear model predicts too asymmetric a decay, while the simultaneous model predicts too symmetrical a break-up. The percolation model, which was adjusted to reproduce the mean multiplicity of fragments and the size of Z_{max}, correctly predicts the charge fluctuations. (orig.).

4615 (GSI–92-35(prepr.)) **Systematics of charm production in hadronic collisions.** Vogt, R. (Gesellschaft fuer Schwerionenforschung mbH, Darmstadt (Germany)); Brodsky, S.J.; Hoyer, P. Gesellschaft fuer Schwerionenforschung mbH, Darmstadt (Germany). May 1992. 52p. Contract DE-AC03-76SF00515. (SLAC-PUB–5827). Order Number DE93728820. Source: OSTI; NTIS (US Sales Only); INIS.

We present a comprehensive QCD-based model for the x_f, p_T, and nuclear target dependence of open charm production in hadron-induced collisions. The predicted dependence of x_f and p_T reflects both leading-twist QCD fusion subprocesses, including shadowing and coalescence effects, and higher-twist intrinsic heavy-quark components of the hadron wavefunction. The model is compared with the systematics of charmed hadron production in π^-p, pp, π^-A, and pA collisions. We find that the date cannot be described by leading-twist QCD contributions alone. Several features of the data show the presence of higher-twist mechanisms of the type we consider. Differences in kinematic acceptance between various experiments may explain some of the apparent discrepancies in the available data. (orig.).

4616 (GSI–92-36(prepr.)) **Nuclear structure studies on exotic nuclei by direct reactions in inverse kinematics.** Egelhof, P. Gesellschaft fuer Schwerionenforschung mbH, Darmstadt (Germany). May 1992. 21p. (CONF-9203164–: International workshop on the physics and techniques of secondary nuclear beams, Dourdan (France), 23-25 Mar 1992). Order Number DE93728816. Source: OSTI; NTIS (US Sales Only); INIS.

The new heavy-ion facilities at GSI Darmstadt allow to investigate light ion induced direct reactions on nuclei in the region away from stability using good quality exotic beams in inverse kinematics. In the present contribution a survey on the physics program addressing a variety of questions in nuclear- and astrophysics is given and the experimental concept is discussed. Special care is given to a comparison of the conditions for cooled and stored exotic beams interacting with an integral target of the heavy-ion storage ring to those for the exotic beams interacting with an external target. Finally, the results of first experiments, as well as the status of new experimental developments, are displayed. (orig.).

4617 (GSI–92-41(prepr.)) **Total and 2n-removal cross sections of the neutron-rich isotopes ^{8,9,11}Li.** Blank, B. (Gesellschaft fuer Schwerionenforschung mbH, Darmstadt (Germany)); Gaimard, J.J.; Geissel, H.; Schmidt, K.H.; Stelzer, H.; Suemmerer, K.; Bazin, D.; Moral, R. del; Dufour, J.P.; Fleury, A.; Hubert, F.; Clerc, H.G.; Steiner, M. Gesellschaft fuer Schwerionenforschung mbH, Darmstadt (Germany). Jun 1992. 30p. Order Number DE93728819. Source: OSTI; NTIS (US Sales Only); INIS.

Total interaction cross sections have been measured for ^{8}Li on C and Pb targets, for ^{9}Li on C, Al, Cu, Sn and Pb targets, as well as for ^{11}Li on C, Sn and Pb targets at about 80 MeV/nucleon. In addition, 2n-removal cross sections for ^{11}Li have been extracted. These measurements are used to determine the nuclear and the electromagnatic part of the cross sections for the different projectile-target combinations. The experimental results are compared to different model calculations. These comparisons allow to draw conclusions on the matter density distribution of the neutron-rich lithium isotope ^{11}Li. By comparing our data on the electromagnetic dissociation of ^{11}Li with all the other data available in the literature, we are able to put constraints on the dipole-strength distribution in ^{11}Li. (orig.).

4618 (GSI–92-52(prepr.)) **Impact-parameter dependence of the electromagnetic particle production in ultrarelativistic heavy-ion collisions.** Vidovic, M. (Frankfurt Univ. (Germany). Inst. fuer Theoretische Physik); Greiner, M.; Best, C.; Soff, G. Gesellschaft fuer Schwerionenforschung mbH, Darmstadt (Germany). Aug 1992. 50p. Order Number DE93729016. Source: OSTI; NTIS (US Sales Only); INIS.

The cross section for the electromagentic production of different particles in heavy-ion collision is derived within the external field approach. The underlying assumption leading to the equivalent photon method is that the transverse components of the virtual photon momenta are small compared to their longitudinal components. Introducing polarized photon-fusion cross sections, it is possible to generalize the equivalent photon method to describe the impact- parameter dependence of the particle production. The impact- parameter dependent production of scalar and pseudoscalar (spin 0) bosons, charged (spin 0) boson pairs and fermion pairs is discussed in general. (orig.).

4619 (GSI–92-53(prepr.)) **Distribution of Ir and Pt isotopes produced as fragments of 1 A GeV ^{197}Au projectiles - a thermometer for peripheral nuclear collisions.** Schmidt, K.H. (Gesellschaft fuer Schwerionenforschung mbH, Darmstadt (Germany)); Geissel, A.; Muenzenberg, G.; Nickel, F.; Pfuetzner, M.; Scheidenberger, C.; Suemmerer, K.; Vieira, D.; Brohm, T.; Clerc, H.G.; Dornik, M.; Fauerbach, M.; Grewe, A.; Hanelt, EGesellschaft fuer Schwerionenforschung mbH, Darmstadt (Germany). Aug 1992. 12p. Order Number DE93728929. Source: OSTI; NTIS (US Sales Only); INIS.

Cross sections of iridium and platinum isotopes have been measured, which were produced as fragments from ^{197}Au projectiles interacting with aluminum target nuclei at 1 A GeV. The fragments were identified by a kinematic analysis (ΔE-Bρ - time-of-flight) and by an ion-optical separation at the projectile-fragment separator FRS at GSI. Indications are found for high excitation energies and weak proton-neutron correlations in the peripheral nuclear-collision process. (orig.).

4620 (GSI–92-56(prepr.)) **Probing the hadronic structure of the photon in ultrarelativistic heavy-ion collisions.** Schneider, S.M. (Frankfurt Univ. (Germany). Inst. fuer Theoretische Physik); Greiner, W.; Soff, G. Gesellschaft fuer Schwerionenforschung mbH, Darmstadt (Germany). Aug 1992. 13p. Order Number DE93729009. Source: OSTI; NTIS (US Sales Only); INIS.

Consequences of the hadronic content of photons on particle creation processes are studied for peripheral heavy-ion collisions at the maximum LHC energy of 3.5 TeV per nucleon. Modifications of the Higgs-boson and quark pair creation rate due to the quark and gluon content of the photons are calculated. In particular, we dound that Z^0 boson creation processes may represent a promising tool to investigate the influence of the internal photon structure in peripheral heavy-ion collision. (orig.).

4621 (IC–92/245) **On intermediate energy heavy Ion optical model potential.** Rihan, T.H. (Al-Fateh, Tripoli (Libya). Dept. of Physics); Awin, A.M. International Centre for Theoretical Physics, Trieste (Italy). Aug 1992. 8p. Order Number DE93608480. Source: OSTI; NTIS (US Sales Only); INIS.

We derive in this paper an approximate analytical expression for the heavy ion optical potential by solving the inversion problem

based on the McIntyre parametrization of the S-matrix. The quasi-classical limit of high energy approximation is modified in our approach so as to account for the Coulomb distortion of the trajectory. (author). 5 refs, 2 figs.

4622 (INDC(CUB)–005/G) **Can be achieved a more accuracy in neutron cross section calculation at low energies?.** Cabezas, R. (Center for Applied Studies to Nuclear Development, Havana (Cuba)); Lubian, J. International Atomic Energy Agency, Vienna (Austria). International Nuclear Data Committee. Mar 1992. 24p. Order Number DE93608468. Source: OSTI; NTIS (US Sales Only); INIS.

The role of some approximations that traditionally are used in the calculation of neutron inelastic cross section for nuclei in the mass region $48 \leq A \leq 64$ is analyzed. It is shown, that the use of different optical potential parameters for ground and first excited states causes a contribution of more than 10% on the cross section. In the description of the structure of "soft" nuclei, the effect of anharmonicities is considered. This effect has a notable contribution to the cross section near the threshold at low energies. For better description of the experimental data in ^{48}Ti(n,n') process, the multichannel coupled model is used. (author). 42 refs, 20 figs, 8 tabs.

4623 (INIS-mf–13375, pp. 52) **Nuclear reaction and decay data for application in research work.** Michel, R.; Baer, K. Tajoura Nuclear Research Centre, Tripoli (Libyan Arab Jamahiriya). 1984. 82p. (CONF-8409421–: Seminar on the use of research reactors in fundamental and applied sciences, Tajoura (Libyan Arab Jamahiriya), 16 Sep 1984). In *Seminar on the use of research reactors in fundamental and applied sciences. Programme and abstracts.* Order Number DE93606515. Source: Also available from Tajoura Nuclear Research Centre, Tajoura/Tripoli, Libya.

Short communication. NUCLEAR DECAY/nuclear data collections; NUCLEAR REACTIONS/nuclear data collections; NEUTRON ACTIVATION ANALYSIS

4624 (INIS-mf–13375, pp. 21) **Measurements of γ-spectra, angular distributions and linear polarizations of γ-quanta in the (n,n'γ) reaction.** Araddad, S.Y. (TNRC, Tripoli (Libya)); Cherepantsev, Y.K.; Demidov, A.M.; Khalifa, M.S.; Leonov, V.F.; Rateb, G.M. Tajoura Nuclear Research Centre, Tripoli (Libyan Arab Jamahiriya). 1984. 82p. (CONF-8409421–: Seminar on the use of research reactors in fundamental and applied sciences, Tajoura (Libyan Arab Jamahiriya), 16 Sep 1984). In *Seminar on the use of research reactors in fundamental and applied sciences. Programme and abstracts.* Order Number DE93606515. Source: Also available from Tajoura Nuclear Research Centre, Tajoura/Tripoli, Libya.

Short communication. NEUTRON REACTIONS/gamma spectra; ANGULAR DISTRIBUTION; NEUTRON SPECTRA; NEUTRONS; SPIN ORIENTATION

4625 (INP–1532/PH) **Nuclear and partonic dynamics in high energy elastic nucleus-nucleus scattering.** Malecki, A. Institute of Nuclear Physics, Cracow (Poland). 1991. 15p. Order Number DE93608475. Source: OSTI; NTIS (US Sales Only); INIS.

A hybrid description of diffraction which combines a geometrical modelling of multiple scattering with many-channel effects resulting from intrinsic dynamics on nuclear and sub-nuclear level is presented. The application to the ^{4}He-^{4}He elastic scattering is very satisfactory. Our analysis suggests that at large momentum transfers the parton constituents of nucleons immersed in nuclei are deconfined. (author).

4626 (INP–1533/PH) **Fluctuations and intermittency in high energy nucleus-nucleus collisions.** Wosiek, B. Institute of Nuclear Physics, Cracow (Poland). Feb 1991. 96p. Order Number DE93608481. Source: OSTI; NTIS (US Sales Only); INIS.

Fluctuations of the particle densities in semi-central collisions of ^{16}O, ^{28}Si and ^{32}S nuclei with heavy components of nuclear emulsion at different primary energies are studied. Various methods of data analysis have been used, ranging from the examination of the structure in individual events, to the study of the average factorial moments and conventional correlation functions. Emphasis is put on the analysis of the average factorial moments which appear to be the most efficient tool in searching for dynamical fluctuations. Unquestionable evidence for non-statistical fluctuations is found in ^{16}O and ^{32}S interactions with Ag/Br targets at 200 GeV/nucleon. Specifically, I observe larger deviations of individual pseudorapidity distributions from a smooth spectrum and more frequent occurrence of narrow spikes than expected from Monte Carlo simulations based on independent emission of secondary particles. Clear intermittency signals are found in pseudorapidity and azimuthal angle distributions. Intermittency effect is also observed in two dimensions, where it has turned out to be stronger and cleaner than in one-dimensional distributions. Multiplicity distributions in the restricted phase space domains are well described by the negative binomial formula and consequently I find that factorial moments can be equivalently obtained from the parameters of the negative binomial fits. On the other hand investigation of the two-particle correlation functions in pseudorapidity provides no supporting evidence for pronounced non-statistical correlations. The occurrence of large particle-density fluctuations is expected in the presence of phase transition in ultrarelativistic nuclear collisions. Even though the obtained results can not be unambigously interpreted as an indication for quark-gluon plasma formation, nevertheless they clearly show that some collective effects are present in high energy nucleus-nucleus collisions. 84 refs. (author).

4627 (INP–1539/PL) **Fusion-fission dynamics.** Blocki, J. (Soltan Inst. for Nuclear Studies, Otwock-Swierk (Poland)); Planeta, R.; Brzychczyk, J.; Grotowski, K. Institute of Nuclear Physics, Cracow (Poland). Apr 1991. 25p. Order Number DE93608482. Source: OSTI; NTIS (US Sales Only); INIS.

Classical dynamical calculations of the heavy ion induced fission process for the reactions ^{40}Ar+^{141}Pr, ^{20}Ne+^{165}Ho and ^{12}C+^{175}Lu leading to the iridium like nucleus have been performed. As a result prescission lifetimes were obtained and compared with the experimental values. The agreement between the calculated and experimental lifetimes indicates that the one-body dissipation picture is much more relevant in describing the fusion-fission dynamics than the two-body one. Somewhat bigger calculated times than the experimental ones in case of the C+Lu reaction at 16 MeV/nucleon may be a signal on the energy range applicability of the one-body dissipation model. (author).

4628 (ITF–91-36) **The dependence of the oriented nuclei electroexcitation cross-section on the electron polarization.** Tartakovskij, V.K.; Lyong Zuen Fu; Fursaev, A.V. AN Ukrainskoj SSR, Kiev (Ukraine). Inst. Teoreticheskoj Fiziki. 1991. 9p. (In Russian). Order Number DE93608461. Source: OSTI; NTIS (US Sales Only); INIS.

The general expression for the differential cross section of the light oriented nuclei electroexcitation by ultrarelativistic polarized electrons, which includes the dependence on the primary and the final degrees of electron polarization is calculated. The physical interpretation is considered. 15 refs. (author).

4629 (ITF–91-52) **Polarization phenomena under low energy photodisintegration of few-nucleon nuclei.** Gurin, Yu.L.; Kozlovskij, I.V.; Malyarzh, E.M.; Tartakovskij, V.K. AN Ukrainskoj SSR, Kiev (Ukraine). Inst. Teoreticheskoj Fiziki. 1991. 20p. (In Russian). Order Number DE93608454. Source: OSTI; NTIS (US Sales Only); INIS.

Polarization of knocked-out nucleons is studied for the deuteron photodisintegration and two-particle photodisintegration of ration of three-nucleon nuclei by polarized and unpolarized low energy photons. The influence of convection and spin currents and of final state interaction on the energy dependence of the polarization degree and polarization vector direction of the knocked-out nucleons is considered for various photon polarization. 21 refs.; 9 figs. (author).

4630 (ITP–91-28) **Proton elastic and quasi-elastic (p,p'd) knock out reactions on ^{6}Li nucleus.** Peresypkin, V.V.; Ibraeva, E.T.; Kukulin, V.I. AN Ukrainskoj SSR, Kiev (Ukraine). Inst. Teoreticheskoj Fiziki. 1991. 16p. Order Number DE93608469. Source: OSTI; NTIS (US Sales Only); INIS.

The elastic proton scattering at energies 0.2, 0.6 and 1.0 GeV and quasi-elastic (p,p'd) knock out reaction on ^{6}Li nucleus are investigated within Glauber-Sitenko theory using the realistic wave functions of a target nucleus. The calculated elastic scattering differential cross-sections agree well with experimental data. The

^{6}Li(p,pd)^{4}He differential cross-sections in noncomplanar geometry within the framework of the plane-wave approximation agree qualitatively with experimental data. The cross-section dependence on the target nucleus wave function form is investigated. 15 refs.; 6 figs. (author).

4631 (ITP–91-42) **Coulomb effects in the proton-deuteron scattering and radiative capture processes at zero energy.** Kharchenko, V.F.; Navrotskij, M.A.; Katerinchuk, P.A. AN Ukrainskoj SSR, Kiev (Ukraine). Inst. Teoreticheskoj Fiziki. 1991. 36p. Order Number DE93608470. Source: OSTI; NTIS (US Sales Only); INIS.

The Coulomb effects in the elastic pd scattering and M1 radiative pd capture processes at zero collision energy are studied on the basis of a direct solution of the integral equations for three nucleons with the S-wave separable NN potential. Taking due account of the Coulomb distortion of three-nucleon system at finite distances and neglecting the long-range part of the polarization pd interaction, the pd scattering lengths and the astrophysical S-factor of the pd capture reaction are calculated. The correlations between the doublet pd and nd scattering lengths as well as between the S-factor for the pd radiative M1 capture at zero energy and the cross section of the thermal nd radiative M1 capture are ascertained. 42 refs.; 3 figs.; 3 tabs. (author).

4632 (ITP–91-56) **Chemical potentials of π^- and π+ in heavy-ion collisions.** Gorenstejn, M.I.; Shin Nan Yang. AN Ukrainskoj SSR, Kiev (Ukraine). Inst. Teoreticheskoj Fiziki. 1991. 8p. Order Number DE93608483. Source: OSTI; NTIS (US Sales Only); INIS.

We consider a chemical nonequilibrium model to describe the pion production in Ar+KCl and La+La collisions at initial energies E_{lab}/A=(0.5-1.8) GeV/nucl. The excess of low energy π^- is interpreted as the manifestation of positive chemical potential of π^- at the thermal freeze out. We find that in collisions between nuclei with large atomic numbers the chemical potential of π^+ is smaller than that of π^-. This leads to the prediction of a much less excess of low-energy π^+, than as measured in the π^- case, in heavy-ion collisions at bombarding energies in the region of 1 GeV/nucl. 17 refs.; 2 figs. (author).

4633 (ITP–91-82) **Pion multiplicity as a probe of the deconfinement transition in heavy-ion collisions.** Gorenstejn, M.I.; Shin Nan Yang; Che Ming Ko. AN Ukrainskoj SSR, Kiev (Ukraine). Inst. Teoreticheskoj Fiziki. 1991. 8p. Order Number DE93608484. Source: OSTI; NTIS (US Sales Only); INIS.

The hydrochemical model is used to calculate the pion multiplicity in relativistic heavy-ion collisions. Chemical reactions are explicitly taken into account in the expansion stage of the hadronic phase. It leads to the absence of chemical equilibrium among hadronic particles and a nonzero value of the pion chemical potential at thermal freeze out. We find a specific structure in the incident energy dependence of the pion multiplicity as a result of the formation of the quark-hadron mixed phase in the initial stage of the collision. 13 refs.; 3 figs.

4634 (JINR-R–1-91-455) **π^--meson production in the interaction of deuterons at 1 GeV per nucleon with carbon and beryllium extended targets.** Viryasov, N.M. (and others); Nagajtsev, A.P.; Solov'ev, M.I. Joint Inst. for Nuclear Research, Dubna (Russian Federation). 1991. 15p. (In Russian). Order Number DE93608476. Source: OSTI; NTIS (US Sales Only); INIS.

The yields, momentum and angular distributions of π^--mesons produced in the interactions of deuterons at 1 GeV per nucleon with the thick carbon and beryllium targets have been obtained. The inelastic cross section of dBe interaction has been measured for the first time. 11 refs.; 7 figs.; 5 tabs.

4635 (KFK–5063) **First observation of the inelastic neutrino-nucleus-scattering ν+^{12}C→ν'+^{12}C*.** Eberhard, V. Kernforschungszentrum Karlsruhe GmbH (Germany). Inst. fuer Kernphysik; Karlsruhe Univ. (T.H.) (Germany). Fakultaet fuer Physik. Aug 1992. 137p. (In German). Order Number DE93729015. Source: OSTI; NTIS (US Sales Only); INIS.

In the main part of this work, the first observation of the neutrino - nucleus excitation due to the weak neutral current. ^{12}C(υ,υ')^{12}C*(1$^+$, 1; 15.1 MeV) is described. The signature of this reaction is based solely on the detection of the 15 MeV Y-quantum emitted in the deexcitation of the ^{12}C(1$^+$1, 15 MeV) level. The detection of this neutrino induced single prong reaction is only possible due to the good calorimetric properties of the KARMEN detector, the efficient background supression and the detailed knowledge of the remaining background. The cross section of the ^{12}C(<$\upsilon,\upsilon\iota$)^{12}C* (1$^+$,1;15.1 MeV) neutrino nucleus excitation, averaged over the υ_e and υ_μ flux from the ISIS beam dump, is found to be <$\sigma(\upsilon_e$ + anti $\nu)$> = (11.4 ± 4.0(stat) ± 1.6 (syst))x10^{-}42 cm^2 which is in good agreement with theoretical values. (orig./HSI).

4636 (SINS–2122/P-6/PH/A) **Pion-source geometry deduced from soft-pion interferometry in heavy-ion collisions at 650 A MeV.** Bock, R. (Gesellschaft fuer Schwerionenforschung mbH, Darmstadt (Germany)); Gutbrod, H.H.; Kolb, B.; Lund, I.; Schmidt, H.R.; Doss, K.G.R.; Kampert, K.H.; Siemiarczuk, T.; Wislicki, W. Soltan Inst. for Nuclear Studies, Otwock-Swierk (Poland). Oct 1991. 18p. Order Number DE93608485. Source: OSTI; NTIS (US Sales Only); INIS.

Report received in March 1992.

We report transverse, R_T, and longitudinal, R_L, source sizes extracted from two-pion interferometry analysis in the Au+Au and Nb+Nb interactions at 650 A MeV. For the Nb+Nb interactions, both, R_T and R_L, do not exceed the niobium nucleus radius. In the case of Au+Au collisions, the transverse size is larger than the longitudinal one being about 12 fm for the selection of p_π + < 120 MeV/c. We also corroborate the existence of the previously reported specific three-pion correlations. (author).

6635 Nuclear Mass Ranges

Refer also to citation(s) 4583, 4584, 4587, 4590, 4591, 4593, 4594, 4597, 4598, 4599, 4601, 4606, 4609, 4610, 4611, 4612, 4613, 4614, 4615, 4617, 4618, 4619, 4621, 4622, 4625, 4634, 4635, 4636, 4738

6636 Radiation Physics

Refer also to citation(s) 2856, 3917, 4609, 4779, 4791, 4792, 4793

4637 (CONF-921046–5) **Status and covariance files of the scattering matrix of graphite.** Difilippo, F.C.; Renier, J.P.; Worley, B.A. Oak Ridge National Lab., TN (United States). [1992]. 7p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. From Symposium on nuclear data evaluation methodology; Upton, NY (United States); 12-16 Oct 1992. Order Number DE93001632. Source: OSTI; NTIS; INIS; GPO Dep.

Calculations related to the temperature coefficient of reactivity of enriched gas-cooled reactors show the high sensitivity of this parameter to the proper description of thermalization effects in the moderator; additionally, calculation of the temperature dependence of the inelastic scattering cross section correlates the errors of the cross sections as functions of the temperature. The ENDF/B evaluation of S(α,β,T) is still based on the approximations (incoherent component only) and phonon spectras of the early 60's. Subsequent measurements showed that the structure observed in S(α,β,T) cannot be described using the incoherent approximation, and soon after the availability of highly intense neutron beams and large specimens of pyrolitic graphite better calculation of the phonon spectra were possible. Our calculations of the probability distributions of the momentum and energy transfer, α and β, allow one to define a range of α and β for which comparison of experimental and theoretical data is of most interest for reactor analysis, and to point out regions of deficient resolution or excessive details in the present α,β mesh used in the ENDF/B files. Because the phonon spectra defines S(α,β,T), we have found mathematical formulas that allow the calculation of the covariance matrix of S by propagating the errors of the phonon spectra.

4638 (DOE/ER/12899–3) **A fundamental study of "contribution" transport theory and channel theory applications: Progress report.** Williams, M.L. Louisiana State Univ., Baton Rouge, LA (United States). [1992]. 6p. Sponsored by USDOE,

Washington, DC (United States). DOE Contract FG02-89ER12899. Order Number DE93004315. Source: OSTI; NTIS; INIS; GPO Dep.

The objective of this three-year study is to develop a technique called "channel theory" that can be used in interpreting particle transport analysis such as frequently required in radiation shielding design and assessment. Channel theory is a technique used to provide insight into the mechanisms by which particles emitted from a source are transported through a complex system and register a response on some detector. It is based on the behavior of a pseudo particle called a "contributon," which is the response carrier through space and energy channels that connect the source and detector. "Contributons" are those particles among all the ones contained in the system which will eventually contribute some amount of response to the detector. The specific goals of this projects are to provide a more fundamental theoretical understanding of the method, and to develop computer programs to apply the techniques to practical problems encountered in radiation transport analysis. The overall project can be divided into three components to meet these objectives: (a) Theoretical Development, (b) Code Development, and (c) Sample Applications. During the present third year of this study, an application of contributon theory to the analysis of radiation heating in a nuclear rocket has been completed, and a paper on the assessment of radiation damage response of an LWR pressure vessel and analysis of radiation propagation through space and energy channels in air at the Hiroshima weapon burst was accepted for publication. A major effort was devoted to developing a new "Contributon Monte Carlo" method, which can improve the efficiency of Monte Carlo calculations of radiation transport by tracking only contributons. The theoretical basis for Contributon Monte Carlo has been completed, and the implementation and testing of the technique is presently being performed.

4639 (DOE/ER/25086–T1) **Fast algorithms for transport models: Technical progress report.** Manteuffel, T.A. Colorado Univ., Denver, CO (United States). 1 Dec 1992. 13p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG02-90ER25086. Order Number DE93003881. Source: OSTI; NTIS; GPO Dep.

The objective of this project is the development of numerical solution techniques for deterministic models of the transport of neutral and charged particles and the demonstration of their effectiveness in both a production environment and on advanced architecture computers. The primary focus is on various versions of the linear Boltzman equation. These equations are fundamental in many important applications. This project is an attempt to integrate the development of numerical algorithms with the process of developing production software. A major thrust of this reject will be the implementation of these algorithms on advanced architecture machines that reside at the Advanced Computing Laboratory (ACL) at Los Alamos National Laboratories (LANL).

4640 (INIS-BR–2972) **Energy spectra of fast neutrons by nuclear emulsion method.** Quaresma, A.A. Instituto Militar de Engenharia (IME), Rio de Janeiro, RJ (Brazil). 1977 127p. (In Portuguese). Order Number DE93608500. Source: OSTI; NTIS (US Sales Only); INIS.

An experimental method which uses nuclear emulsion plates to determine the energy spectrum of fission neutrons is described. By using this technique, we have obtained the energy distribution of neutrons from spontaneous fission of Cf^{252}. The results are in good agreement with whose obtained previously by others authors who have used different detection techniques, and they are consistent with a Maxwellian distribution as expected by Weisskopf's nuclear evaporation theory. (author).

4641 (INIS-BR–2982) **Study of a method to solve the one speed, three dimensional transport equation using the finite element method and the associated Legendre function.** Fernandes, A. Instituto de Pesquisas Energeticas e Nucleares (IPEN), Sao Paulo, SP (Brazil). 1991 181p. (In Portuguese). Order Number DE93607644. Source: OSTI; NTIS (US Sales Only); INIS.

A method to solve three dimensional neutron transport equation and it is based on the original work suggested by J.K. Fletcher (42, 43). The angular dependence of the flux is approximated by associated Legendre functions and the finite element method is applied to the space components is presented. When the angular flux, the scattering cross section and the neutrons source are expanded in associated Legendre functions, the first order neutron transport equation is reduced to a coupled set of second order diffusion like equations. These equations are solved in an iterative way by the finite element method to the moments. (author).

4642 (INIS-mf–13375, pp. 4) **Attenuation of fission neutrons in serpentine sand and serpentine concrete.** Akki, A.S. (Tajoura Nuclear Research Centre, Secretariat of Atomic Energy, Tripoli (Libya)); Megahid, R.M. Tajoura Nuclear Research Centre, Tripoli (Libyan Arab Jamahiriya). 1984. 82p. (CONF-8409421–: Seminar on the use of research reactors in fundamental and applied sciences, Tajoura (Libyan Arab Jamahiriya), 16 Sep 1984). In *Seminar on the use of research reactors in fundamental and applied sciences. Programme and abstracts.* Order Number DE93606515. Source: Also available from Tajoura Nuclear Research Centre, Tajoura/Tripoli, Libya.

Short communication. CONCRETES/fission neutrons; CONCRETES/shielding materials; SAND/fission neutrons; SAND/shielding materials; ATTENUATION; CONCRETES; ENERGY SPECTRA; NEUTRON FLUX; SAND; SPHERICAL CONFIGURATION

4643 (KAERI/RR–1084/91) **A study on nuclear materials by neutron scattering.** Kim, Huhn Jun (Korea Atomic Energy Research Inst., Daeduk (Korea, Republic of)); Kim, Yong Che; Chun, Byung Chil; Lee, Chang Hee; Lee, Jeong Soo; Seong, Beak Seok; Shim, Hae Seop; Choi, Byong Hoon; Ho, Jong Wha. Korea Atomic Energy Research Inst., Daeduk (Korea, Republic of). Feb 1992. 108p. (In Korean). Order Number DE93606181. Source: OSTI; NTIS (US Sales Only); INIS.

To establish quantitative relationship between texture and elastic anisotropy we measured 4 pole figures for each of the two zircaloy-4 sheet samples with thickness 1.95mm and 0.965mm by neutron diffraction and evaluated the elastic constants of the materials by averaging those of Zr single crystal weighted with crystallites orientation distribution functions(ODF). Based on the average elastic constants for polycrystals, angular dependent ultrasonic wave velocities of SH_0 and S_0 mode were estimated for comparison with measurement. Various preparatory works are under way to install mutually complementary neutron spectrometers to the 7 horizontal beam tubes of the KMRR. Under the plan to transport and install the polarized neutron spectrometer(PNS) present at TRIGA MARK-III, several modifications and upgrade works have been initiated such as estimation of the properties of polarizing monochromator and neutron beam intensity characteristics at ST-1 beam tube. The resolution and the incident intensity at the sample of the small angle neutron spectrometer (SANS) at design stage are evaluated for the limited reactor hall space using cold neutron(4-10A). (Author).

4644 (KFK–4708) **PLXY - a code for the solution of the multigroup neutron transport equation x-y geometry by a spherical harmonics method of general order.** Kobayashi, Keisuke. Kernforschungszentrum Karlsruhe GmbH (Germany). Inst. fuer Neutronenphysik und Reaktortechnik; Kernforschungszentrum Karlsruhe GmbH (Germany). Projekt Nukleare Sicherheitsforschung. Jul 1991. 117p. Order Number DE93729013. Source: OSTI; NTIS (US Sales Only); INIS.

The code PLXY solves the multigroup neutron transport equation by the spherical harmonics (P_L) method for two-dimensional x-y geometry allowing a general order (L) of approximation by the spherical harmonics functions. There exists no principal limit for the order L of the spherical harmonics expansion except the practical limitations for the size of the memory and the computation time of the available computer. Within the group anisotropic scattering cross-section is taken into account with higher order approximation, but the slowing-down cross-section and the external source as well as fission neutrons are presently for simplicity reasons assumed to be isotropic in the laboratory system. The explicit form of the equantions, the discretization scheme for the mesh-edged finite difference solution scheme, a detailed explanation of the computer program and the format of the input data are given together with sample problems. (orig.).

4645 (ORNL/RSIC–55) **Early test facilities and analytic methods for radiation shielding: Proceedings.** Ingersoll, D.T.

(comp.) (Oak Ridge National Lab., TN (United States)); Ingersoll, J.K. (comp.). Oak Ridge National Lab., TN (United States). Nov 1992. 94p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. (CONF-921102–: Joint American Nuclear Society (ANS)/European Nuclear Society (ENS) international meeting on fifty years of controlled nuclear chain reaction: past, present, and future, Chicago, IL (United States), 15-20 Nov 1992). Order Number DE93003288. Source: OSTI; NTIS; INIS; GPO Dep.

This report represents a compilation of eight papers presented at the 1992 American Nuclear Society/European Nuclear Society International Meeting. The meeting is of special significance since it commemorates the fiftieth anniversary of the first controlled nuclear chain reaction. The papers contained in this report were presented in a special session organized by the Radiation Protection and Shielding Division in keeping with the historical theme of the meeting. The paper titles are good indicators of their content and are: (1) The origin of radiation shielding research: The Oak Ridge experience, (2) Shielding research at the hanford site, (3) Aircraft shielding experiments at General Dynamics Fort Worth, 1950-1962, (4) Where have the neutrons gone?, a history of the tower shielding facility, (5) History and evolution of buildup factors, (6) Early shielding research at Bettis atomic power laboratory, (7) UK reactor shielding: then and now, (8) A very personal view of the development of radiation shielding theory.

4646 (SAND–92-7296) **Improved response functions for gamma-ray skyshine analyses.** Shultis, J.K. (Kansas State Univ., Manhattan, KS (United States). Dept. of Nuclear Engineering); Faw, R.E.; Deng, X. Sandia National Labs., Albuquerque, NM (United States); Kansas State Univ., Manhattan, KS (United States). Dept. of Nuclear Engineering. Sep 1992. 113p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-76DP00789. Order Number DE93003230. Source: OSTI; NTIS; GPO Dep.

A computationally simple method, based on line-beam response functions, is refined for estimating gamma skyshine dose rates. Critical to this method is the availability of an accurate approximation for the line-beam response function (LBRF). In this study the LBRF is evaluated accurately with the point-kernel technique using recent photon interaction data. Various approximations to the LBRF are considered, and a three parameter formula is selected as the most practical approximation. By fitting the approximating formula to point-kernel results, a set of parameters is obtained that allows the LBRF to be quickly and accurately evaluated for energies between 0.01 and 15 MeV, for source-to-detector distances from 1 to 3000 m, and for beam angles from 0 to 180 degrees. This reevaluation of the approximate LBRF gives better accuracy, especially at low energies, over a greater source-to-detector range than do previous LBRF approximations. A conical beam response function is also introduced for application to skyshine sources that are azimuthally symmetric about a vertical axis. The new response functions are then applied to three simple skyshine geometries (an open silo geometry, an infinite wall, and a rectangular four-wall building) and the results compared to previous calculations and benchmark data.

6640 Atomic and Molecular Physics

4647 (GSI–92-60(prepr.)) **Latest hot topics in atomic physics research in GSI.** Kienle, P. Gesellschaft fuer Schwerionenforschung mbH, Darmstadt (Germany). Sep 1992. 28p. (CONF-9206275–: Nobel symposium on heavy ion spectroscopy and QED effects in atomic systems, Saltsjoebaden (Sweden), 29 Jun - 3 jul 1992). Order Number DE93729011. Source: OSTI; NTIS (US Sales Only); INIS.

A report on the recent atomic physics program at GSI is given. The synchrotron storage cooler ring combination SIS/ESR allows to produce, store and cool highly charged heavyion beams up to U^{92+}. With the availability of such highly charged ion beams unique experiments have become possible, such as the observation of bound β decay of $^{163}Ho^{66+}$, the precision measurement of radiative electron capture and X-ray spectra in H-like and He-like heavy ions, and the investigation of dielectronic recombination for heavy systems. Beside this newly started program at SIS/ESR there has been some progress in the investigation of the correlated $e^+ e^-$ lines observed in heavy ion collisions near the Coulomb barrier although a convincing explanation for this phenomenon is still lacking. (orig.).

6641 Theory of Electronic Structure of Atoms and Molecules

Refer also to citation(s) 4438, 4449

4648 (IC–92/231) **Wave function collapse phenomenon in the Na isoelectronic sequence.** Tiwary, S.N. International Centre for Theoretical Physics, Trieste (Italy). Sep 1992. 12p. Order Number DE93608512. Source: OSTI; NTIS (US Sales Only); INIS.

We report Hartree-Fock and configuration-interaction calculations of both the length and velocity forms of the oscillator strengths for the resonance excitation $1s^22s^22p^63s^2S^e_1 \rightarrow 1s^22s^22p^53s^2\ ^2P^0_1$, transition, which leads to autoionization (Auger transition), in several ions of the sodium isoelectronic sequence both in LS and intermediate coupling schemes employing the collapse of wave functions of 3p and 3d electrons. This approach is computationally economical and capable of yielding encouraging results. (author). 5 refs, 1 fig., 5 tabs.

4649 (IC–92/236) **Two-photon emission spectrum of a two-level atom in a cavity.** He Linsheng (International Centre for Theoretical Physics, Trieste (Italy)); Fen Xunli. International Centre for Theoretical Physics, Trieste (Italy). Sep 1992. 16p. Order Number DE93608513. Source: OSTI; NTIS (US Sales Only); INIS.

We have studied the two-photon emission spectrum (TPES) of a two-level atom interaction with a single mode of radiation field in an ideal cavity. By means of the two-photon Jaynes-Cummings model and Heisenberg equation, we have obtained the expressions of system operators and TPES. We find that the structures of TPES depend on the photon statistics distribution of initial field and the pass-band width of detector Γ. When $\Gamma < \lambda$ (coupling constant), TPES exhibits the multi-peaked structure. (author). 18 refs, 12 figs, 2 tabs.

4650 (IC–92/242) **Electronic Landau levels in quantum wells with periodically structured interfaces.** Sun Hong. International Centre for Theoretical Physics, Trieste (Italy). Sep 1992. 23p. Order Number DE93608514. Source: OSTI; NTIS (US Sales Only); INIS.

The energy dispersions of the electronic Landau levels in GaAs/$Al_xGa_{1-x}As$ lateral surface superlattices (LSSLs) with periodically structured interfaces in a normally applied static magnetic field are calculated numerically. The results show that the energy dispersions of the adjacent Landau levels are out of phases, which greatly reduces the energy gaps between the adjacent energy bands. For certain interface structures, the energy gaps will disappear giving a continuous distribution of the electronic states in the energy space. The effects of the periodically structured interfaces become negligible when the periods of the structured interfaces are much less than the extension, modul Δx modul $= 2\sqrt{}$ hc/eB, of the electronic wave functions in magnetic fields. The results also show that the approximation assuming an infinitely high potential barrier between the well GaAs and barrier $Al_xGa_{1-x}As$ is not very accurate in calculating the electronic Landau levels in LSSLs with periodically structured interfaces. The changes of the energy dispersions of the electronic Landau levels with the magnetic fields and structural parameters of LSSLs are studied in detail. (author). 22 refs, 5 figs.

4651 (IC–92/249) **Ground-state energy for 1D (t,U,X)-model at low densities.** Buzatu, F.D. International Centre for Theoretical Physics, Trieste (Italy). Sep 1992. 9p. Order Number DE93608515. Source: OSTI; NTIS (US Sales Only); INIS.

In describing the properties of quasi-1D materials with a highly-screened interelectronic potential, an attractive hopping term has to be added to the Hubbard Hamiltonian. The effective interaction and the ground-state energy in ladder approximation are analyzed. At low electronic densities, the attractive part of the interaction, initially smaller than the repulsive term, can become more effective, the ground-state energy decreasing below the unperturbed value. (author). 12 refs, 4 figs.

4652 (RAL–92-034) **Electron correlation in molecules: concurrent computation Many-Body Perturbation Theory (ccMBPT) calculations using macrotasking on the NEC SX-3/44 computer.** Moncrieff, D. (Florida State Univ., Tallahassee, FL (United States). Supercomputer Computations Research Inst.); Saunders, V.R.; Wilson, S. Rutherford Appleton Lab., Chilton (United Kingdom). Jun 1992. 25p. Order Number DE93608516. Source: OSTI; NTIS (US Sales Only); INIS.

The ab initio determination of the electronic structure of molecules is a many-fermion problem involving the approximate description of the motion of the electrons in the field of fixed nuclei. It is an area of research which demands considerable computational resources but having enormous potential in fields as diverse as interstellar chemistry and drug design, catalysis and solid state chemistry, molecular biology and environmental chemistry. Electronic structure calculations almost invariably divide into two main stages: the approximate solution of an independent electron model, in which each electron moves in the average field created by the other electrons in the system, and then, the more computationally demanding determination of a series of corrections to this model, the electron correlation effects. The many-body perturbation theory expansion affords a systematic description of correlation effects, which leads directly to algorithms which are suitable for concurrent computation. We term this concurrent computation Many-Body Perturbation Theory (ccMBPT). The use of a dynamic load balancing technique on the NEC SX-3/44 computer in electron correlation calculations is investigated for the calculation of the most demanding energy component in the most accurate of contemporary ab initio studies. An application to the ground state of the nitrogen molecule is described. We also briefly discuss the extent to which the calculation of the dominant corrections to such studies can be rendered computationally tractable by exploiting both the vector processing and parallel processor capabilities of the NEC SX-3/44 computer. (author).

6642 Spectra of Atoms and Molecules and Their Interactions With Photons

Refer also to citation(s) 3955, 3966, 4671

4653 (BNL–47995) **X-ray absorption spectroscopy beyond the core-hole lifetime.** Haemaelaeinen, K.; Hastings, J.B.; Siddons, D.P.; Berman, L. Brookhaven National Lab., Upton, NY (United States). [1992]. 3p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC02-76CH00016. (CONF-9208160–2: 7. international conference on x-ray absorption fine structure, Kobe (Japan), 23-29 Aug 1992). Order Number DE93001977. Source: OSTI; NTIS; INIS; GPO Dep.

A new technique to overcome the core-hole lifetime broadening in x-ray absorption spectroscopy is presented. It utilizes a high resolution fluorescence spectrometer which can be used to analyze the fluorescence photon energy with better resolution than the natural lifetime width. Furthermore, the high resolution spectrometer can also be used to select the final state in the fluorescence process which can offer spin selectivity even without long range magnetic order in the sample.

4654 (IC–92/235) **The Optical Stark effect of the exciton due to dynamical coupling between quantized states of the electron and hole in quantum wells.** Nguyen Hong Quang. International Centre for Theoretical Physics, Trieste (Italy). Aug 1992. 10p. Order Number DE93608520. Source: OSTI; NTIS (US Sales Only); INIS.

Optical Stark effect of the exciton in quantum wells is treated by taking into account not only dynamical coupling by pump field between quantized states of the electron in the conduction band but also the coupling between quantized states of the hole in the valence band. The changes in the calculated one-photon absorption probability by exciton depend essentially on pump field detuning. (author). 19 refs, 3 figs.

4655 (IC–92/243) **Cavitiless dielectric-waveguide-mode generation in a weakly amplifying gaseous medium.** Izmailov, I.A. (International Centre for Theoretical Physics, Trieste (Italy)); Kochelap, V.A.; Mel'nikov, L.Yu. International Centre for Theoretical Physics, Trieste (Italy). Sep 1992. 26p. Order Number DE93608521. Source: OSTI; NTIS (US Sales Only); INIS.

A possibility is studied of transformation of stored energy in inverse media with excited metastable molecules or atoms into energy of waveguide modes localized in a dielectric waveguide with small losses. A condition for generation is shown to fulfill for specific type of the localized modes of the closed waveguide. A grating of waveguides is investigated for a medium with homogeneous pumping. A flow of a stream of metastable species through a grating of independent waveguides is studied. The dependence is obtained of efficiency of energy transformation and dimensions of the region of generation on the spatial density of the waveguide surface. Numerical calculations are presented for $O_2(a\ ^1\Delta)$ and $I(^2P_{1/2})$. Practical applications of a cavitiless waveguide laser are discussed. (author). 9 refs, 4 figs, 5 tabs.

4656 (IC–92/247) **Chaotic dynamics of high density photon an exciton system.** Nguyen Trung Dan (International Centre for Theoretical Physics, Trieste (Italy)); Nguyen Ba An; Le Ngoc Minh. International Centre for Theoretical Physics, Trieste (Italy). Aug 1992. 19p. Order Number DE93608522. Source: OSTI; NTIS (US Sales Only); INIS.

We consider nonlinear dynamics of a system of interacting photons and excitons driven by a resonantly exciting light field. Using the linear stability analysis for nonlinear coupled equations of photon and exciton operators we investigated that, besides the usual unstable domain which is negative slope branch, there are other unstable ones in the leftmost and rightmost sides of the lower and upper branches of the frequency-density bistable curves. Numerical study shows that the system has very rich information on the instability nature and a self-oscillation process leading to chaos can occur in these unstable domains. (author). 11 refs, 9 figs.

4657 (INIS-BR–3020) **Differential perturbed angular correlation: use of physico-chemical study of some hafnium complexes derivates of hydroxy acids and EDTA.** Silveira, J.G. da. Minas Gerais Univ., Belo Horizonte, MG (Brazil). Inst. de Ciencias Exatas. 1981 132p. (In Portuguese). Order Number DE93608523. Source: OSTI; NTIS (US Sales Only); INIS.

Measures of quadrupolar interaction to nucleus level of the metal, in some hafnium complexes are presented, including the analysis by combustion, microanalysis, infrared spectroscopy and thermogravimetry. The hyperfine interaction parameters, the temperature effects and the thermal neutrons capture effects over the irradiated Hf Y (Y = EDTA) are also studied. (author).

4658 (INIS-BR–3051) **Photoemission in the Anderson model for rare earth compounds with floating valences.** Frota, H.O. da. Sao Paulo Univ., Sao Carlos, SP (Brazil). Inst. de Fisica e Quimica. 1985 161p. (In Portuguese). Order Number DE93608524. Source: OSTI; NTIS (US Sales Only); INIS.

X-ray photoemission spectra (XPS) are calculated for the spin-degenerate Anderson model of valence fluctuation compounds. Based on the renormalization group technique originally introduced by Wilson to calculate the magnetic susceptibility for the Kondo model, the numerical calculation has uniform accuracy over the entire parameter space of the Anderson model; at any given photoelectron energy, a maximum error of 4% is estimated for the calculated photoemission current. The calculated spectra display two peaks associated with the two possible x-ray induced transitions between the $n_f = 0,1$ or 2 occupations of the f-orbital: a first ionization peak corresponding to the $n_f = 2 \rightarrow n_f = 1$ transition and a second ionization peak due to the $n_f\ 1 \rightarrow n_f = 0$ transition. (author).

4659 (UCRL-JC–111468) **Spectroscopy of highly charged multi-electron ions.** Beiersdorfer, P. Lawrence Livermore National Lab., CA (United States). 16 Sep 1992. 10p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. (CONF-920948–3: 6. international conference on physics of highly charged ions, Manhattan, KS (United States), 28 Sep - 2 oct 1992). Order Number DE93001617. Source: OSTI; NTIS; INIS; GPO Dep.

Systematic studies of highs charged neonlike and nickellike ions as well as several open-shell ions performed on an electron beam

ion trap are described and used to assess the accuracy of structure calculations of multi-electron ions. Discrepancies are found that can be attributed to inaccuracies in accounting for electron correlations and in estimating quantum electrodynamical effects. Documenting the effects of level crossings, we demonstrate that these discrepancies are compounded by uncertainties in assigning the respective contributions from quantum electrodynamics to each of the two strongly interacting levels undergoing the crossing.

6643 Collision Phenomena

Refer also to citation(s) 3788, 3959, 4669, 4736

4660 (ANL/CP–774) **Cluster-molecule systems: Analysis and tuning of the interaction potential.** Jellinek, J.; Guevenc, Z.B. Argonne National Lab., IL (United States). 16 Sep 1992. 6p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-31109-ENG-38. (CONF-920921–3: 6. international symposium on small particles and inorganic clusters, Chicago, IL (United States), 16-22 Sep 1992). Order Number DE93000601. Source: OSTI; NTIS; GPO Dep.

The interaction (modelled by a LEPS potential) of a D_2 molecule with an icosahedral Ni_{13} cluster is mapped and analyzed in the form of equipotential contour plots. The topological features of the map correlate with the energetic and dynamical characteristics of the dissociative adsorption of the molecule on the cluster, which were extracted from quasiclassical trajectory simulations. A modification of the LEPS potential used originally is introduced. It brings the calculated reactivity of the cluster into agreement with the experimental data.

4661 (CONF-920948–5) **Low-energy measurements of electron capture by multicharged ions from excited hydrogen atoms.** Havener, C.C. (Oak Ridge National Lab., TN (United States)); Haque, M.A.; Smith, A.C.H.; Urbain, X.; Zeijlmans van Emmichoven, P.A. Oak Ridge National Lab., TN (United States). [1992]. 10p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400 ;AC05-76OR00033. From 6. international conference on physics of highly charged ions; Manhattan, KS (United States); 28 Sep - 2 oct 1992. Order Number DE93001642. Source: OSTI; NTIS; INIS; GPO Dep.

For very low collision energies electron capture from excited hydrogen by multicharged ions is characterized by enormous cross sections, the predicted maximum being comparable to the geometric size of the Rydberg atom. The ion-atom merged-beams technique is being used to study these collisions for the variety of charge states and the wide range of energies (0.1 to 1000 eV/amu) accessible to the apparatus. A neutral D beam containing a Rydberg atom population proportional to $1/n^3$ is produced by collisional electron detachment of 8 key D^- in N_2 gas. An applied electric field results in a truncation of the maximum principal quantum number present in the beam in the range (n=24-11) depending on the strength of the field applied. This beam is then merged with O^{3+} or O^{5+} ion beams at low relative collision velocities where the resultant beam-beam signal of D^+ due to electron loss is dominated by electron capture. From the sharp decrease in the observed beam-beam signal as the electric field increases it is inferred that the electron capture cross section scales as n^4 increasing towards n^5 for collision energies below 1 eV/amu.

4662 (CONF-921116–4) **Angular distributions of charge exchange collisions at very low energies.** Keller, N. (Tennessee Univ., Knoxville, TN (United States). Dept. of Physics); Miller, R.D.; Westerlind, M.; Andersson, L.R.; Elston, S.B.; Sellin, I.A.; Biedermann, C. Oak Ridge National Lab., TN (United States). [1992]. 12p. Sponsored by USDOE, Washington, DC (United States); National Science Foundation, Washington, DC (United States); Swedish National Science Research Council (Sweden). DOE Contract AC05-84OR21400. From 12. international conference on the application of accelerators in research and industry; Denton, TX (United States); 2-5 Nov 1992. Order Number DE93002338. Source: OSTI; NTIS; INIS; GPO Dep.

We have measured angular distributions of double-electron capture in $C^{4+} \rightarrow$ He collisions at energies between 400 and 800 eV. The experimental energy-gain spectra show that the ground state of C^{2+} ($1s^2\ 2s^2$) is populated. In the angular distributions we observe an interference pattern which is attributed to Stueckelberg oscillations. We find additional structures in the spectra that are no related to the Stueckelberg interferences. The presented results are compared to experimental data as well as theoretical calculations by other authors.

4663 (DOE/ER/53188–9) **Experimental investigations of electron capture from atomic hydrogen and deuterium by alpha particles: Annual progress report, 15 September 1991–14 September 1992.** Gay, T.J.; Park, J.T. Missouri Univ., Rolla, MO (United States). Div. of Applied Plasma Physics. [1992]. 106p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG02-84ER53188. Order Number DE93002654. Source: OSTI; NTIS; INIS; GPO Dep.

We report progress made during the period 15 September 1991–14 September 1992 on the project "Experimental Investigations of Electron Capture from Atomic Hydrogen and Deuterium by Alpha Particles". In the past year we have developed reliable, narrow energy spread, high-current sources of He^{++} based on direct-current magentron and electron-cyclotron resonance discharges. These sources have been proven on our test bench accelerator which has been upgraded to also allow us to test atomic hydrogen effusive targets. We have thus made substantial progress toward our goal of studying single electron capture from atomic hydrogen by doubly-ionized helium. A research plan for the upcoming year is also presented.

4664 (DOE/ER/54104–1) **Relativistic calculations of excitation and ionization of highly charged ions by electron impact: Final technical report.** Sampson, D.H. Pennsylvania State Univ., University Park, PA (United States). 15 Apr 1992. 13p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG02-90ER54104. Order Number DE93002129. Source: OSTI; NTIS; INIS; GPO Dep.

Our rapid relativistic atomic structure program and relativistic distorted-wave programs for excitation and ionization of highly charged ions were further improved. The generalized Briet interaction and other QED corrections were added to the atomic structure program, and the speed of the distorted-wave excitation program was increased by over an order of magnitude over what it was when our initial large-scale relativistic calculations of excitation of Ne-like ions were made. The improved programs were then used to calculate collision strengths for 330 transitions in F-like ions with $22 \leq Z \leq 92$ and 248 transitions in Ni-like ions with $60 \leq Z \leq 92$. We expanded the relativistic collision program to include an option to use atomic structure data by the well-known multi-configuration Dirac-Fock (MCDF) program of Grant and A coworkers. This was used in calculating collision strengths for the 45 $\Delta n = 0$ transitions with n=2 in Be-like ions with $8 \leq Z \leq 92$. This relativistic collision strength program was also extended to include an option to include the generalized Breis interaction in the scattering matrix elements and the importance of this for He-like, He-like and Li-like ions with Z = 26, 54 and 92 was studied. The factorization method was applied to ionization. Regardless of the complexity of the ion the ionization cross sections could be written as a sum of the products of a readily calculated coefficient that depends only on ion properties and a hydrogen-like cross section. Work was also done on excitation and ionization by directive and, in some cases spin-polarized electrons, which is of interest for some EBIT experiments and the study of solar flares.

4665 (GSI–92-49(prepr.)) **Investigations of correlated e^+e^- emission in heavy-ion collisions near the Coulomb barrier.** Koenig, I.; Berdermann, E.; Bosch, F.; Kienle, P.; Koenig, W.; Kozhuharov, C.; Schroeter, A.; Tsertos, H. Gesellschaft fuer Schwerionenforschung mbH, Darmstadt (Germany). Aug 1992. 53p. Order Number DE93728899. Source: OSTI; NTIS (US Sales Only); INIS.

We present the results obtained from a series of e^+e^--coincidence measurements in heavy-ion collisions using the double-Orange β-spectrometer at GSI. The collision systems U+U, U+Pb, and U+Ta were investigated at bombarding energies close to and slightly above (U+Ta) the Coulomb barrier. For all systems studied, very narrow (FWHM$\simeq$20 keV) e^+e^- lines were observed in the sum-energy spectra, with kinetic energies ranging from $\simeq$

555 keV to $\simeq$ 810 keV, superimposed on a continuous distribution mainly due to uncorrelated e^+e^- emission. Particularly in the U+Ta system, a pronounced sum-energy line appears at $\simeq$ 634 keV, predominantly in deep-inelastic collisions. In some cases (e.g. U+Pb) the line characteristics is consistent with a two-body decay mode of an emitter which moves with the c.m. velocity of the colliding ions. However, other lines, and in particular the 634 keV line (U+Ta), exhibit a rather isotropical opening-angle distribution whereas their energy is unequally shared between positrons and electrons, thus being in clear disagreement with this scenario. In general, the data preclude an emission from the separated (moving) nuclei, and, in the latter cases, provide evidence that the e^+e^--pair decay occurs in the vicinity of the Coulomb field of a third heavy partner having only a small transverse velocity (vertical stroke$v_{perpendicular\ to}$vertical stroke$<0.02c$). (orig.).

4666 (IC–92/206) **AGFA differential cross sections for the excitation $1s^2S^e \rightarrow 2s^2Se$ transitions in H by electron impact at 1 Rydberg.** Tiwary, S.N. International Centre for Theoretical Physics, Trieste (Italy). Aug 1992. 11p. Order Number DE93608535. Source: OSTI; NTIS (US Sales Only); INIS.

We have calculated the differential cross sections for the excitation $1s^2S^e \rightarrow 2s^2Se$ transition in the hydrogen atomic system by electron impact using the basis functions (1s-2s-2p) within the Asymptotic Green Function Approximation (AGFA) at an incident energy 1 Rydberg. Our present results qualitatively agree with out earlier R-matrix prediction. (author). 33 refs, 1 fig.

4667 (IC–92/207) **H^+ impact ionization of Ar.** Tiwary, S.N. International Centre for Theoretical Physics, Trieste (Italy). Aug 1992. 10p. Order Number DE93608536. Source: OSTI; NTIS (US Sales Only); INIS.

We present calculations of the ionization cross sections of the collisional reaction $H^+ + Ar(1s^22s^22p^63s^23p^6\ ^1Se) \rightarrow H^+ + e^- + Ar^+(1s^22s^22p^63s^13p^6\ ^2Se)$ using configuration-interaction wave function within the binary encounter approximation. Comparison is made with available results. (author). 45 refs, 1 fig.

4668 (LBL–32440) **Collision dynamics of methyl radicals and highly vibrationally excited molecules using crossed molecular beams.** Chu, P.M.Y. Lawrence Berkeley Lab., CA (United States). Oct 1991. 130p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC03-76SF00098. Order Number DE92041194. Source: OSTI; NTIS; INIS; GPO Dep.

The vibrational to translational (V→T) energy transfer in collisions between large highly vibrationally excited polyatomics and rare gases was investigated by time-of-flight techniques. Two different methods, UV excitation followed by internal conversion and infrared multiphoton excitation (IRMPE), were used to form vibrationally excited molecular beams of hexafluorobenzene and sulfur hexafluoride, respectively. The product translational energy was found to be independent of the vibrational excitation. These results indicate that the probability distribution function for V→T energy transfer is peaked at zero. The collisional relaxation of large polyatomic molecules with rare gases most likely occurs through a rotationally mediated process. Photodissociation of nitrobenzene in a molecular beam was studied at 266 nm. Two primary dissociation channels were identified including simple bond rupture to produce nitrogen dioxide and phenyl radical and isomerization to form nitric oxide and phenoxy radical. The time-of-flight spectra indicate that simple bond rupture and isomerization occurs via two different mechanisms. Secondary dissociation of the phenoxy radicals to carbon monoxide and cyclopentadienyl radicals was observed as well as secondary photodissociation of phenyl radical to give H atom and benzyne. A supersonic methyl radical beam source is developed. The beam source configuration and conditions were optimized for CH_3 production from the thermal decomposition of azomethane. Elastic scattering of methyl radical and neon was used to differentiate between the methyl radicals and the residual azomethane in the molecular beam.

6644 Experimentally Derived Information On Atomic and Molecular Properties

Refer also to citation(s) 4661, 4683, 4695, 4707, 4736

4669 (DOE/ER/13456–44) **Correlation in photodetachment.** Pegg, D.J. (Tennessee Univ., Knoxville, TN (United States). Dept. of Physics). Tennessee Univ., Knoxville, TN (United States). Dept. of Physics. [1992]. 11p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG05-85ER13456 ;AC05-84OR21400. Order Number DE93001843. Source: OSTI; NTIS; INIS; GPO Dep.

Electron correlation plays a major role in all aspects of the photodetachment of an electron from a negative ion. Photodetachment measurements are well suited to investigate the relatively short range forces associated with correlation due to the absence of the long range Coulomb interaction. Measurements of electron affinities, asymmetry parameters and cross sections are described to illustrate the influence of correlation on photodetachment.

4670 (DOE/ER/14145–T2) **Physics of correlated systems: Progress report, December 1, 1991–November 30, 1992.** Greene, C.H. Colorado Univ., Boulder, CO (United States). [1992]. 3p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG02-90ER14145. Order Number DE93002842. Source: OSTI; NTIS; INIS; GPO Dep.

This report discusses the following topics: spectra of heavy open- shell atoms; multiphoton ionization processes in real atoms; angular distribution of photoelectrons ejected from aligned two-electron atoms; and few-electron correlations.

4671 (LUTFD2-TFAF–1020-1-66-1992) **The hyperfine structure - a message from the inner circle.** Sturesson, L. Lund Univ. (Sweden). Dept. of Physics. Jun 1992. 149p. (LRAP–129.). Order Number DE93608541. Source: OSTI; NTIS; INIS.

Experiment have been performed to determine the lifetimes and the hyperfine structures of excited states in atoms. Decay curves were recorded with the aid of time-resolved laser spectroscopy. From these curves, it was possible to evaluated the lifetimes with high accuracy. In certain cases, the hyperfine structures were also determined with high accuracy form quantum beat signals. The elements studied were lithium, sodium, copper, iron and silver. In favourable cases, the method of delayed coincidence gave uncertainties in lifetime measurements of about 0.5%. The detection of quantum beat signals with frequencies higher than 1 GHz was demonstrated. The effects of non-white excitation and delayed detection on level-crossing signals were also investigated. The method of delayed detection causes a narrowing of the detected signal, though most of the intensity of the signals is lost and it exhibits an oscillatory behaviour due to the gating procedure. The effect of high-intensity beams in combination with optically dense media applied to saturation absorption spectroscopy has been investigated both theoretically and experimentally. In this regime the signals exhibited sharp profiles, with widths narrower than the natural linewidth, duel to the non-linearity of the medium. Also, a strong rejection of the background was achieved. These features make this regime interesting for frequency stabilization purpose. Using wavefunctions calculated with the multi-configuration Hartree-Fock method, the hyperfine structure interaction constants of the 3s ^2S and the 3p ^2P states in ^{23}Na and the 3s3p $^{1,3}P$ and the 3s3d $^{1,3}D$ states in 25 Mg, the only stable isotope of magnesium with a hyperfine structure, were determined. (62 refs.) (au).

6645 Special Atoms and Molecules

Refer also to citation(s) 4572

4672 (IC–92/218) **Binding and excitation energies of Lennard-Jones clusters in the 1/d-method.** Gonzalez, A. (International Centre for Theoretical Physics, Trieste (Italy)); Leal, D. International Centre for Theoretical Physics, Trieste (Italy). Aug 1992. 17p. Order Number DE93608542. Source: OSTI; NTIS (US Sales Only); INIS.

We present simple estimates of the binding energies of clusters of rare-gas atoms and excitation energies of low-lying states in trimers, which are obtained by writing formally the Schroedinger equation in d dimensions and expanding its solution in powers of 1/d. Comparison with Monte Carlo calculations for Lennard-Jones clusters (Ne_n, Ar_n, Kr_n, Xe_n, n=3-7 and 13) shows good agreement, and suggests that our formulae may be used to estimate the

energy of rare-gas atoms interacting through realistic potentials. (author). 24 refs, 1 fig., 2 tabs.

6650 Physics of Condensed Matter

Refer also to citation(s) 3567, 3570, 3577, 3589, 3600, 3601, 3662, 3787, 4650, 4651, 4695, 4774

4673 (DOE/ER/13821–6) **Complex temporal and spatial patterns in nonequilibrium processes: Progress report, December 1, 1987–November 30, 1992.** Swinney, H.L. Texas Univ., Austin, TX (United States). [1992]. 12p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG05-88ER13821. Order Number DE93001845. Source: OSTI; NTIS; INIS; GPO Dep.

We have used dynamical systems methods to study and characterize bifurcations and pattern formation in a variety of nonequilibrium systems. In this paper we describe our work on dynamical systems, chemical oscillations and chaos, chemical spatial patterns, instabilities in fluid dynamics, electrodeposition clusters, the ballast resistor, and crack propagation.

4674 (DOE/ER/13919–5) **[List and drag forces on droplets and particles in wall-bounded shear flows]: Technical progress report.** McLaughlin, J.B. Clarkson Univ., Potsdam, NY (United States). Dept. of Chemical Engineering. [1992]. 10p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG02-88ER13919. Order Number DE93002678. Source: OSTI; NTIS; GPO Dep.

This project has two goals, to calculate the lift force on a spherical droplet or particle that translates through a shear flow, and to measure the inertial migration velocity that is caused by the lift force. The focus of the study is on a range of Reynolds numbers that has been shown to be of importance in the inertial deposition of aerosols from turbulent shear flows. Aspects of current technical progress summarized are the asymptotic analysis, computer simulations, and experimental measurements. Future plans and resulting publications are given.

4675 (LBL–32714) **D^- centers in high magnetic fields and quantum wells.** Zhu, J. (Lawrence Berkeley Lab., CA (United States)); Louie, S.G.; Pang, T. Lawrence Berkeley Lab., CA (United States). Aug 1992. 8p. Sponsored by USDOE, Washington, DC (United States); National Science Foundation, Washington, DC (United States). DOE Contract AC03-76SF00098. Grant DMR-9120269. (CONF-9208163–1: 5. international conference on shallow impurities in semiconductors, Kobe (Japan), 5-8 Aug 1992). Order Number DE93000567. Source: OSTI; NTIS; GPO Dep.

The ground-state and optical properties of negative donor (D^-) centers in strong magnetic fields and quantum wells are studied using the effective mass theory. The exact ground-state binding energy is calculated to within statistical noise by a diffusion quantum Monte Carlo inethod. Excited state and optical transition energies are computed by carrying out variational Monte Carlo calculations. Comparison with available magneto-optical data of D^- centers in bulk GaAs and in $GaAs/Al_xGa_{1-x}As$ quantum wells shows good agreement between theory and experiment over a range of magnetic field strengths.

6651 Nuclear Techniques In Condensed Matter Physics

Refer also to citation(s) 3774, 4034

4676 (BNL–48003) **Synchrotron radiation induced x-ray micro analysis: A realistic alternative for electron- and ion beam microscopy?.** Janssens, K. (Universitaire Instelling Antwerpen, Antwerp (Belgium). Dept. of Chemistry); Adams, F.; Rivers, M.L.; Jones, K.W. Brookhaven National Lab., Upton, NY (United States). [1992]. 49p. Sponsored by USDOE, Washington, DC (United States); National Science Foundation, Washington, DC (United States); Belgian National Science Fund (Belgium). DOE Contract AC02-76CH00016. Grant Nr. 2009291N;Grant EAR 89-14669. (CONF-9208150–1: 27. annual meeting of the Microbeam Analysis Society (MAS) (United States) and the 19th annual meeting of the Microscopical Society of Canada (MSC), Boston, MA (United States), Aug 1992). Order Number DE93001975. Source: OSTI; NTIS; INIS; GPO Dep.

To be published in The Microbeam Analysis Journal.

Synchrotron Radiation induced X-ray micro Fluorescence analysis (μ-SRXRF) is compared with more conventional microanalytical techniques such as Secondary Ion Microscopy (SIMS) and Electron Probe X-ray Microanalysis (EPXMA) for two typical microanalytical applications. SRXRF and EPXMA are employed for the analysis of individual particles, showing the complementary character of both techniques. By means of element mapping of trace constituents in a heterogeneous feldspar, the strong and weak points of SRXRF in comparison to EPXMA and SIMS are illustrated. The most striking difference between SRXRF and the other two microanalytical methods is the ability of SRXRF to probe deep into the investigated Material, whereas SIMS and EPXMA only investigate the upper surface of the material. The possibilities of SRXRF at third generation synchrotron rings is also briefly discussed.

4677 (CONF-921201–4) **Spin density waves in dilute CuMn alloys.** Cable, J.W. (Oak Ridge National Lab., TN (United States)); Tsunoda, Y. Oak Ridge National Lab., TN (United States). [1992]. 11p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. From Conference on magnetism and magnetic materials; Houston, TX (United States); 1-4 Dec 1992. Order Number DE93001628. Source: OSTI; NTIS; INIS; GPO Dep.

Neutron scattering studies on concentrated CuMn alloys show static spin density waves (SDW) that are incommensurate with the lattice and which become dynamic above the freezing temperature T_f with a dispersion relation that is essentially vertical. We have examined the existence of both the static and the dynamic SDW in dilute CuMn alloys where the Mn atoms may be separated beyond the range of SDW stability. There is no such cutoff range in the Overhauser SDW model where the transition temperature is simply linear with concentration, but a recent calculation by Ioffe and Feigel'man gives magnetic order that does depend on an interaction range and the density of spins on the lattice. For CuMn alloys, they obtain spin-glass ordering at low Mn concentration with a crossover to short-range helical order near 10% Mn. Our neutron scattering measurements were made on single crystals of CuMn alloys containing 1.4 and 3.0% Mn. Elastic scans along $<1\zeta 0>$ at temperatures well below T_f yield the same type of intensity distribution as that previously observed for the more concentrated alloys and show the existence of static SDW at dilutions down to 1.4% Mn. Inelastic scans in the same Q region for the Cu-3% Mn alloy clearly show the presence of dynamic SDW at temperatures up to $T/T_f = 7.5$. These results favor the SDW model of Overhauser as the best description of the magnetic order in dilute CuMn alloys.

4678 (CONF-921201–5) **High-energy magnetic excitations in $Mn_{90}Cu_{10}$.** Fernandez-Baca, J.A. (Oak Ridge National Lab., TN (United States)); Nicklow, R.M.; Hagen, M.E.; Perring, T.G.; Tsunoda, Y. Oak Ridge National Lab., TN (United States). [1992]. 13p. Sponsored by USDOE, Washington, DC (United States); Science and Engineering Research Council, Swindon (United Kingdom); North Atlantic Treaty Organization, Brussels (Belgium). DOE Contract AC05-84OR21400. Grant GRC-900626. From Conference on magnetism and magnetic materials; Houston, TX (United States); 1-4 Dec 1992. Order Number DE93001634. Source: OSTI; NTIS; INIS; GPO Dep.

The study of the magnetic excitations in Mn-rich alloys should be a good test of the multiband calculations of the spin dynamics of pure γ-Mn, which is a prototypical itinerantelectron antiferromagnet. In this paper we report the results of recent neutron inelastic scattering measurements performed on $Mn_{90}Cu_{10}$ at room temperature ($T = 0.63\ T_N$) and up to 300 meV of energy transfer. These measurements were performed using the HET chopper-spectrometer at the ISIS spallation neutron source, Rutherford Appleton Laboratory, U.K. The results have been compared with calculations using a model scattering function convoluted with the full HET resolution function. In this model there is a steep linear spin-wave dispersion ($D \approx 250$ meV-Å) for wavevectors up to $\approx \frac{1}{2}$ of the Brillouin zone and a strong damping which is linear in the wavevector q. For larger wavevectors the spin-wave energies are constant at about

190 meV. These features are qualitatively similar to the predictions of Cade and Yeung for pure γ-Mn.

4679 (CONF-921201–6) **A neutron scattering study of the quasi-one-dimensional, dilute Ising-like antiferromagnet $CsCo_{0.83}Mg_{0.17}Br_3$.** Rogge, R.B. (McMaster Univ., Hamilton, ON (Canada). Dept. of Physics and Astronomy); Gaulin, B.D.; Yang, Y.S.; Tun, Z.; Fernandez-Baca, J.A.; Nicklow, R.M. Oak Ridge National Lab., TN (United States). [1992]. 10p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. From Conference on magnetism and magnetic materials; Houston, TX (United States); 1-4 Dec 1992. Order Number DE93001718. Source: OSTI; NTIS; INIS; GPO Dep.

Neutron scattering measurements have been performed on a single crystal sample of $CsCo_{0.83}Mg_{0.17}Br_3$, a quasi-one-dimensional, Ising-like antiferromagnet. Residual three-dimensional interactions between the dilute magnetic chains precipitate a phase transition to long range order at $T_N \sim 8.5$ K, and short range correlations persist as high as 40 K. Relatively high energy inelastic scattering from both "bulk" spin wave modes and "end" modes is observed from the finite chains. The low energy inelastic spectrum is dominated by soliton scattering due to anti-phase domain walls propagating along the finite chains.

4680 (INIS-BR–3037) **Moessbauer spectrometry study and metallography of paramagnetic phases from zirconium-iron system.** Freitas Brandao Bittencourt, C. de. Instituto Militar de Engenharia (IME), Rio de Janeiro, RJ (Brazil). 1976 57p. (In Portuguese). Order Number DE93608607. Source: OSTI; NTIS (US Sales Only); INIS.

Binary alloys of zirconium with 3 to 23% of iron by weight, were made by diffusion at 875^0 C of iron onto thin plates of zirconium. Moessbauer spectroscopy and optic metallography indicated the phases Zr_2 Fe and Zr_4 Fe, the bulk of which probably formed during the diffusion. These phases were confirmed by electron probe microanalysis. Moessbauer spectra showed quadrupole doublets with the same hyperfine interaction parameters in both phases, but with clearly distinct asymmetries. (author).

4681 (INIS-mf–13375, pp. 19) **Neutron structural investigations in the TRC.** Elzawi, R.A.; Hamouda, S.A.; Khalf, F.M. Tajoura Nuclear Research Centre, Tripoli (Libyan Arab Jamahiriya). 1984. 82p. (CONF-8409421–: Seminar on the use of research reactors in fundamental and applied sciences, Tajoura (Libyan Arab Jamahiriya), 16 Sep 1984). In *Seminar on the use of research reactors in fundamental and applied sciences. Programme and abstracts.* Order Number DE93606515. Source: Also available from Tajoura Nuclear Research Centre, Tajoura/Tripoli, Libya.

Short communication. NEUTRON DIFFRACTION; MAGNETIC MATERIALS

6653 Interactions Between Beams and Condensed Matter

Refer also to citation(s) 2857, 3647, 3993, 4657, 4793

4682 (IC–92/175) **Excitonic bistabilities, instabilities and chaos in laser-pumped semiconductor.** Nguyen Ba An (Institute of Theoretical Physics, Hanoi (Viet Nam)); Nguyen Trung Dan; Hoang Xuan Nguyen. International Centre for Theoretical Physics, Trieste (Italy). Jul 1992. 15p. Order Number DE93608677. Source: OSTI; NTIS (US Sales Only); INIS.

The Hurwitz criteria are used for a stability analysis of the steady state excitonic optical bistability curves in a semiconductor pumped by an external laser resonant with the exciton level. Besides the middle branch of the bistability curves which is unstable in the sense of the linear stability theory, we have found other domains of instability in the upper and lower branches of the steady state curves. Numerical results show that a possible route to chaos in the photon-exciton system is period-doubling self-oscillation process. The influence of the presence of free carriers that coexist with the excitons is also discussed. (author). 16 refs, 6 figs.

4683 (LA-UR–92-2913) **Equilibrium charge state distributions of 1–30 keV atomic projectiles transiting thin carbon foils.** Funsten, H.O.; Barraclough, B.L.; McComas, D.J. Los Alamos National Lab., NM (United States). [1992]. 12p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. (CONF-9209200–5: 8. international conference on ion beam modification of materials, Heidelberg (Germany), 7-11 Sep 1992). Order Number DE93000792. Source: OSTI; NTIS; INIS; GPO Dep.

We have investigated the exit charge state distributions of 1–30 keV H, He, C, N, O, Ne, and Ar ions that transit thin carbon foils. In this velocity regime which is less than the Bohr velocity, the dominant charge states are neutrals and singly positive ions. Therefore, the charge state distributions are dependent primarily on electron loss by neutrals with an associated electron loss cross section al and electron capture by singly ionized species with an associated electron capture cross section σ_c. Using empirical charge state distributions, the ratio σ_1/σ_c is shown to have a quadratic dependence on the projectile velocity and is fit to the equation $A(E_F\text{-}E_T)/m$ where E_F is the exit projectile energy, m is its mass, and A and E_T are constants. A pronounced shell effect is observed: the constant A is dependent on the principle quantum number of the projectile, and E_T depends on the number of projectile valence electrons.

6654 Quantum Physics Aspects of Condensed Matter

4684 (IC–92/250) **On the magnetoresistance of heavy fermion compounds.** Lee Chengchung (International Centre for Theoretical Physics, Trieste (Italy)); Chen Chung. International Centre for Theoretical Physics, Trieste (Italy). Sep 1992. 24p. Order Number DE93608691. Source: OSTI; NTIS (US Sales Only); INIS.

Starting from two-conduction-band Anderson lattice model, the magneto-transport properties of heavy fermion systems are studied in the slave boson mean field theory. The residual magnetoresistivity induced by different kinds of impurities is calculated, and the experimentally detected positive maximum structure in the residual magnetoresistance of heavy fermion systems is reproduced. The transition of field-dependent resistivity from nonmonotonic to monotonic behaviour with increasing temperature can be explained naturally by including the charge fluctuation effect. The influence of applied pressure is also investigated. (author). 22 refs, 5 figs.

4685 (IC–92/251) **Nonlinear response function for two-phonon polaritons.** Stoychev, K.T. International Centre for Theoretical Physics, Trieste (Italy). Sep 1992. 15p. Order Number DE93608692. Source: OSTI; NTIS (US Sales Only); INIS.

A nonlinear response function describing three-polariton processes (two single-phonon polaritons and two-phonon polariton) is derived for a system of interaction phonons and photons. The main features of the nonlinear optical spectra in the two-phonon polariton region are analyzed. (author). 17 refs.

4686 (IC–92/252) **Exciton solitary waves in molecular crystals.** Primatarowa, M.T. (Bulgarian Academy of Sciences, Sofia (Bulgaria). Inst. of Solid State Physics); Stoychev, K.T. International Centre for Theoretical Physics, Trieste (Italy). Sep 1992. 27p. Order Number DE93608693. Source: OSTI; NTIS (US Sales Only); INIS.

Solitary waves formed of nonlinear intramolecular excitations (electronic or vibrational excitons) are investigated. Bell- and kink-type solutions are obtained and the conditions for their existence are determined. Effects of the exciton dispersion on the properties of the solitons in gyrotropic as well as nongyrotropic crystals are analyzed. The dispersion is shown to produce changes of the type of the solution inside the Brillouin zone, accompanied by a critical behaviour of some soliton parameters. (author). 27 refs, 5 figs.

665410 Superconductivity

Refer also to citation(s) 3567, 3613, 3618, 3620, 3625, 3639, 4005, 4010, 4470, 4496, 4750

4687 (AECS-S/RSS–41) **High temperature superconductivity: Concept, preparation and testing of high Tc superconductor compounds, and applications.** Harara, Wafik (Atomic Energy Commission, Damascus (Syrian Arab Republic)). Atomic Energy Commission, Damascus (Syrian Arab Republic).

Jun 1992. 25p. (In Arabic). Order Number DE93608696. Source: OSTI; NTIS (US Sales Only); INIS.

Many studies have been carried out on high temperature superconductors with transition temperature above that of the liquid nitrogen. In this scientific study the concept and the mechanism of this phenomena are discussed, in addition the examples of preparation and testing of high temperature superconductors compounds are shown. Also the most important applications in industry are explained. (author). 15 refs., 2 tabs., 18 figs.

4688 (ANL/MSD/CP–77834) **Generic properties of layered superconductors.** Klemm, R.A. Argonne National Lab., IL (United States). Oct 1992. 9p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-31109-ENG-38. (CONF-920944–5: 6. annual New York State Institute on Superconductivity (NYSIS) conference on superconductivity and applications, Buffalo, NY (United States), 15-17 Sep 1992). Order Number DE93002985. Source: OSTI; NTIS; GPO Dep.

A wide variety of layered materials have been found to be superconducting. Among these are graphite intercalation donor compounds, transition metal dichalcogenides, intercalated transition metal dichalcogenides, organic layered superconductors, artificial superlattices, and the cuprates. The normal state properties of all of these compounds are very similar, due to the fact that they all have well-defined Fermi surfaces, and quasi-linear in-plane resistivities at high temperatures. At lower temperatures, charge- or spin-density waves are common in these systems. With the exception of the graphite intercalation compounds, all of the fayered superconductors are type-II, and generally highly anisotropic in their superconducting properties. Dimensional crossover from anisotropic bulk to thin film behavior is common to many of these materials.

4689 (DOE/ER/40077–10) **High field superconductor development and understanding: A. Establishing the limits of performance of niobium-titanium; B. Establishing whether Chevrel phase materials could become useful high field superconductors: Final report.** Larbalestier, D.C.; Lee, P.J. Wisconsin Univ., Madison, WI (United States). Applied Superconductivity Center. May 1991. 21p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC02-82ER40077. Order Number DE93005009. Source: OSTI; NTIS; INIS; GPO Dep.

Rapid progress in the development of high current density conductor in the period 1982–1992. At the beginning of this period the best strand for the FermiLab Tevatron was attaining 2000a/mm^2 at 5T (4.2K), with variable product quality; by 1991 commercial strand was obtainable at over 3000A/mm^2 in very long piece lengths. The most important contribution to this advance was the understanding of the role of the Nb-Ti microstructure in the determination of the intrinsic current carrying capacity of the strand. A complete wire fabrication facility was created at the UW making it possible to control all aspects of strand production. These facilities further accelerated our understanding of the extrinsic processing limitations to the J_c of the conductors. Results on Chevrel phase materials ($PbMo_8$) showed that HIP-ed samples had complete connectivity; there is no intrinsic granularity to Chevrel phases. Flux pinning was studied in $SnNo_6S_8$.

4690 (DOE/ER/45347–32) **[Strongly interacting fermion systems] annual progress report, November 15, 1992–November 14, 1993.** Ohio State Univ. Research Foundation, Columbus, OH (United States). [1992]. 7p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG02-88ER45347. Order Number DE93002839. Source: OSTI; NTIS; GPO Dep.

the research has been concentrated in four areas: Methodology for large-scale or innovative computing; computation of complex structures or properties; many-body fermion systems (but not including superconductors); properties of many-body fermion systems believed to be relevant for high-temperature superconductors. All of these areas we put under the rubric of "strongly interacting fermions systems." The first two areas are more concerned with computational aspects and the latter two to specific problems with a stronger analytic aspect. However, in our Proposal Section we return to the appropriateness of the rubric "strongly interacting fermions."

4691 (IC–92/211) **Microscopic origin of marginal Fermi-liquid in strongly correlated spin systems.** Protogenov, A.P. (International Centre for Theoretical Physics, Trieste (Italy)); Ryndyk, D.A. International Centre for Theoretical Physics, Trieste (Italy). Aug 1992. 15p. Order Number DE93608697. Source: OSTI; NTIS (US Sales Only); INIS.

We consider the consequences of separation of spin and charge degrees of freedom in 2+1D strongly correlated spin systems. Self-consistent spin and charge motions induced by doping in sites of ground and dual lattices form such a spectrum of quasiparticles which together with the dispersionless character of the collective excitation spectrum and the chemical potential pinning in the band centre yield the necessary behavior of charge and spin polarizability to support the theory of marginal liquid formulated by C.M. Varma et al. (Phys. Rev. Lett. 63, 1996 (1989)). (author). 28 refs, 4 figs.

4692 (IC–92/229) **Dependence of critical exponents on θ parameter in anyon lattice model.** Protegenov, A.P. (International Centre for Theoretical Physics, Trieste (Italy)); Verbus, V.A. International Centre for Theoretical Physics, Trieste (Italy). Aug 1992. 9p. Order Number DE93608698. Source: OSTI; NTIS (US Sales Only); INIS.

The critical behaviour in the Z_N model with θ-parameter is considered in the Coulomb gas representation. We focus our attention on the dependence of the critical exponents of the correlation functions of the Z_N-theory with $\theta=2\pi/N$ on the rank N of the group. (author). 20 refs.

4693 (KFK–4988) **Stability of superconducting cables for use in large magnet systems.** Schmidt, C. (Kernforschungszentrum Karlsruhe GmbH (Germany)); Tateishi, H. Kernforschungszentrum Karlsruhe GmbH (Germany). Inst. fuer Technische Physik; Kernforschungszentrum Karlsruhe GmbH (Germany). Projekt Kernfusion. Mar 1992. 32p. (In German). Order Number DE93742166. Source: OSTI; NTIS (US Sales Only); INIS.

The construction of large superconducting magnets requires the development of complicated conductor types, which can fulfill the specific requirements of different types of magnets. A rather hard boundary condition for large magnets is the presence of fast changing magnetic fields. In the Institute of Technical Physics a superconduction cable was developed for use in poloidal field coils in Tokamak experiments. This 'POLO'-cable exhibits low losses in a magnetic ac-field and a high stability margin. In the present article the requirements on a superconducting cable are described, as well as the mechanisms of ac-losses and the calculation of the stability limit. Calculated values are compared with experimental data. Some unresolved problems concerning the stability of large magnets are discussed taking the example of the POLO-cable. (orig.).

4694 (KFK–5008) **Numerical study of a 50 kA superconducting bus for the NET/ITER model coil test in TOSKA-upgrade.** Heller, R. Kernforschungszentrum Karlsruhe GmbH (Germany). Inst. fuer Technische Physik; Kernforschungszentrum Karlsruhe GmbH (Germany). Projekt Kernfusion. Mar 1992. 62p. Order Number DE93742165. Source: OSTI; NTIS (US Sales Only); INIS.

Based on the design of the supreconducting bus bar system for the 1.8 K test of the EURATOM LCT coil in the TOSKA Upgrade facility, a superconducting bus bar was designed for the NET/ITER model coil test for an operating current of 50 kA made out of a NbTi cable-in-conduit-conductor imbedded in a copper profile for electrical and mechanical stabilization. For safety reasons, the mass flow through the bus bar is designed as a separate circuit, i.e. the mass flow rates of the coil pancakes, the bus bar, and the current lead are independently adjustable. This results in a bus bar which is safe in case of loss of cooling. But the eddy current losses generated in the stabilizing cooper during the fast discharge of the model coils are by far too high, i.e. the bus bar will quench during high magnetic field changes. Therefore, alternatives are discussed in which the design principles of the bus bar were not changed but it was tried to reduce the eddy current losses in the copper stabilizer. The only possible alternative as a superconducting bus bar consisting of a cable-in-conduit(-CIC)-conductor without any stabilizing copper profile around it. The CIC is imbedded in a jacket made of stainless steel for mechanical stability. The calculations show that

this type of bus bar has a high safety margin with respect to AC-losses. In this report, the different designs are described, and the computational results are presented. (orig./GSCH).

4695 (LA-UR–92-3057) **The local structure of high-temperature superconductors.** Mustre de Leon, J.; Conradson, S.D.; Bishop, A.R.; Raistrick, I.D. Los Alamos National Lab., NM (United States). [1992]. 6p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. (CONF-9208160–1: 7. international conference on x-ray absorption fine structure, Kobe (Japan), 23-29 Aug 1992). Order Number DE93000653. Source: OSTI; NTIS; INIS; GPO Dep.

We show how x-ray absorption fine structure (XAFS) has been successfully used in the determination of the local crystal structure of high-temperature superconductors, with advantages over traditional diffraction techniques. We review the experimental results that yielded the first evidence for an axial-oxygen-centered lattice instability connected with the superconductivity transition. The interpretation of this instability in terms of a dynamical tunneling model suggests the presence of polarons in these materials. XAFS on $Tl_2Ba_2CuO_6$ and other Tl-based superconductors indicate the presence of local instabilities in the CuO_2 planes of these materials, in addition to axial-oxygen instabilities.

4696 (LBL–32150) **Design of high-T_c superconducting bolometers for a far infrared imaging array.** Verghese, S. (Lawrence Berkeley Lab., CA (United States)); Richards, P.L.; Fork, D.K.; Char, K.; Geballe, T.H. Lawrence Berkeley Lab., CA (United States). Aug 1992. 7p. Sponsored by USDOE, Washington, DC (United States); Department of Defense, Washington, DC (United States). DOE Contract AC03-76SF00098. F49620-89-C-0017. (CONF-920802–33: Applied superconductivity conference, Chicago, IL (United States), 23-28 Aug 1992). Order Number DE93002564. Source: OSTI; NTIS; GPO Dep.

The design of high-T_c superconducting bolometers for use in a far infrared imaging array from wavelengths 30–100μm is discussed. Measurements of the voltage noise in thin films of $YBa_2CU_3O_{7-\epsilon}$ on yttria-stabilized zirconia buffer layers on silicon substrates are used to make performance estimates. Useful opportunities exist for imaging and spectroscopy with bolometer arrays made on micro-machined silicon membranes. A circuit on each pixel which performs some signal integration can improve the sensitivity of large two-dimensional arrays of bolometers which use multiplexed readout amplifiers.

4697 (LBL–32660) **The fabrication and performance of $YBa_2Cu_3O_{7-x}$ SQUID magnetometers.** Kingston, J.J. Lawrence Berkeley Lab., CA (United States). Jul 1992. 126p. Sponsored by USDOE, Washington, DC (United States); California Competitive Technology Program, CA (United States). DOE Contract AC03-76SF00098. Order Number DE93002561. Source: OSTI; NTIS; GPO Dep.

To enhance the SQUID's field sensitivity, it is coupled to a flux transformer, a closed superconducting circuit consisting of a pickup loop, to which a signal is applied, connected in series to an input coil, which is inductively coupled to the SQUID. To fabricate an optimal flux transformer, one must use more than one superconducting thin-film layer, each of which is patterned into narrow strips or wires. Some wires from different layers cross, yet remain electrically isolated, to form crossovers, while in other places there must be superconducting contact between wires from different layers. Together, the superconducting wire, superconducting-superconducting contact and the superconducting crossover constitute a superconducting interconnect or multilayer wiring technology. We discuss the development of an interconnect technology involving the high transition temperature (T_c) superconductor $YBa_2Cu_3O_{7-x}$ (YBCO). Because of the need for epitaxial growth there are limits on materials for the insulating layer separating the YBCO films in multilayer structures, and on deposition and patterning techniques. We discuss the use of pulsed laser deposition in conjunction with patterning by shadow masks and later by photolithography to produce interconnects, multiturn input coils, and flux transformers. We also discuss the performance of SQUID magnetometers, in which a flux transformer fabricated on one substrate is coupled to a SQUID fabricated on another. The first magnetometers were hybrids – high $T_c$transformers coupled to low T_cSQUIDS, while later ones had both high $T_c$transformers and SQUIDs and could operate immersed in liquid nitrogen. We report on a magnetometer with a magnetic field sensitivity at lHz of about $2pTHz^{-1/2}$ at 77K, that was successfully used to perform magnetocardiograms on human subjects.

4698 **Process for producing clad superconductive materials.** Cass, R.B.; Ott, K.C.; Peterson, D.E. To Dept. of Energy. 19 Mar 1991. USAA patent application 7-671,23. 10p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. Order Number DE93002030. Source: OSTI; NTIS; GPO Dep.

A process for fabricating superconducting composite wire by the steps of placing a superconductive precursor admixture capable of undergoing a self propagating combustion in stoichiometric amounts sufficient to form a superconductive product within a metal tube, sealing one end of said tube, igniting said superconductive precursor admixture whereby said superconductive precursor admixture endburns along the length of the admixture, and cross-section reducing said tube at a rate substantially equal to the rate of burning of said superconductive precursor admixture and at a point substantially planar with the burnfront of the superconductive precursor mixture, whereby a clad superconductive product is formed in situ, the product characterized as superconductive without a subsequent sintering stage, is disclosed.

4699 (SAND–92-1913C) **Flux flow microelectronics.** Martens, J.S. (Sandia National Labs., Albuquerque, NM (United States)); Hietala, V.M.; Plut, T.A.; Ginley, D.S.; Vawter, G.A.; Tigges, C.P.; Siegal, M.P.; Phillips, J.M.; Hou, S.Y. Sandia National Labs., Albuquerque, NM (United States). [1992]. 8p. Sponsored by USDOE, Washington, DC (United States); Department of Defense, Washington, DC (United States). DOE Contract AC04-76DP00789. (CONF-920802–24: Applied superconductivity conference, Chicago, IL (United States), 23-28 Aug 1992). Order Number DE93000756. Source: OSTI; NTIS; GPO Dep.

Flux-flow based devices such as the superconducting flux flow transistor and magnetically controlled long junctions have been made from thin films of TlCaBaCuO and YBaCuO. The devices are based on the magnetic control of flux flow in their respective structures: a long junction or an array of weak links. The equivalent circuits of the two devices are similar: a low impedance input control line, an output impedance of 3–20 Ω and an active current-controlled element. The long junctions have tended to be slower, have lower gain and be somewhat less noisy than their counterparts. The performance of circuits such as narrowband and distributed amplifiers (50 GHz bandwidths, noise figures < 3 dB), phase shifters (continuous with < 2dB loss 4–40 GHz), logic gates (2–3 ps gate delays) and memories made using these devices will be compared and analyzed.

665420 Superfluidity

4700 (IC–92/244) **New edge magnetoplasmon for a two-dimensional electron gas in a ring geometry.** Proetto, C.R. International Centre for Theoretical Physics, Trieste (Italy). Sep 1992. 12p. Order Number DE93608737. Source: OSTI; NTIS (US Sales Only); INIS.

The dynamical response of a classical two-dimensional electron gas confined in a ring geometry under a perpendicular magnetic field is analysed. Within the hydrodynamical approach and in the strong magnetic field limit, a new set of antidot edge magnetoplasmons is obtained, corresponding to density oscillations circulating along the inner boundary of the ring and whose frequency increases with magnetic field. The associated self-induced distribution of densities and currents are presented, together with an analysis of the size dependence of these perimeter waves. (author). 15 refs, 4 figs.

665430 Other Topics in Quantum Fluids and Solids

4701 (INIS-BR–2983) **Determination of thermal diffusivity at low temperature using the two-beam phase-lag photoacoustic method with observation of phase-transitions.** Jorge, M.P.P. Instituto de Pesquisas Energeticas e Nucleares (IPEN), Sao Paulo, SP (Brazil). 1992 93p. (In Portuguese). Order Number DE93608738. Source: OSTI; NTIS (US Sales Only); INIS.

This study consists of the determination of thermal diffusivity int he temperature range from 77 K to 300 K by the two-beam phase-lag photoacoustic method. Room temperature measurements of NTD (neutron transmutation doping) silicon suggest that the doping process does not affect its thermal properties. For the superconductor Y Ba_2 Cu_3 O_{7-x} it has been verified that the sample density affects its thermal diffusivity. The validity of the experimental method on the Li K SO_4 crystal has been examined by using the thermal diffusivity of a Li F crystal and an Y_2 O_3 ceramic, at room temperature. The behavior of the thermal diffusivity as a function of the temperature for the Li K SO_4 crystal shows two anomalies which correspond at phase-transitions of this crystal in the studied temperature range. (author).

4702 (INIS-BR–2992) **Effect of planar magnetic field on electron transport properties of n-AlGaAs/GaAs heterojunction and photoluminescence measures in GaAs samples.** Alves, A.R. Minas Gerais Univ., Belo Horizonte, MG (Brazil). Dept. de Fisica. 1991 104p. (In Portuguese). Order Number DE93608739. Source: OSTI; NTIS (US Sales Only); INIS.

The effects of magnetic fields applied parallel to the interface of an heterojunction n-Al Ga As is studied. A qualitative analysis has shown that this field modifies the Fermi surface of the two dimensional electron gas (2 DEG) confined on the heterojunction. it produces a strong asymmetry on the magnetoresistance of the 2 DEG relative to the two directions of the electric current. This interpretation is confirmed by a self-consistent numerical calculation involving a solution of the Schroedinger and Poisson equations. To verify this result, measurements with samples grown by Molecular Beam Epitaxy (MBE) under magnetic fields up to 13.0 T are performed and the results obtained confirm the asymmetry in the magnetoresistance. Also, a strong negative magnetoresistance attributed to the imperfections of the interface is seen. It can be used to evaluate the quality of the heterojunction interface. The details about the implantation of the photoluminescence measurement system are discussed. Spectra of an asymmetric quantum well and delta-doped Ga As : Si samples at 300 K and 55 K are shown. (author).

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Refer also to citation(s) 4738, 4739, 4754

4703 (CONF-920913–18) **Poloidal flow generation by resistive pressure-gradient-driven turbulence.** Garcia, L. (Universidad Complutense and Asociacion Euratom-Ciemat, Madrid (Spain)); Carreras, B.A.; Lynch, V.E.; Diamond, P.H. Oak Ridge National Lab., TN (United States). [1992]. 9p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. From 14. international conference on plasma physics and controlled nuclear fusion research; Wuerzburg (Germany); 30 Sep - 7 oct 1992. Order Number DE93001638. Source: OSTI; NTIS; INIS; GPO Dep.

The radial structure of poloidal flows and radial electric fields in the tokamak plasma edge plays an important role in determining global confinement properties. In a turbulent plasma, poloidal flow can be generated through the Reynolds stress. At the same time, this poloidal flow controls the level of fluctuations. Thererfore, self-consistent calculations of plasma turbulence in the presence of flows are needed to identify the mechanism of confinement improvement. Here, we study the interaction. Linearly, both the shear flow, $V_\theta' \neq 0$, and the curvature flow, $V_\theta'' \neq 0$, are stabilizing. Nonlinearly, the effect of the shear flow is weak, while the curvature flow is robust and survives in the nonlinear regime.

4704 (CTH-IEFT-PP–1992-14) **Velocity shear effects in the problem of the electron temperature gradient instability induced by conducting end-walls.** Ryutov, D.; Weiland, J. Chalmers Univ. of Technology, Goeteborg (Sweden). Inst. for Electromagnetic Field Theory and Plasma Physics. [1992]. 26p. Order Number DE93608546. Source: OSTI; NTIS; INIS.

The effects of shear in the ExB drift velocity are studied in connection with the recently discovered electron temperature gradient driven instability induced by conducting end plates. The transition between the temperature gradient driven mode and the Helmholtz-Kelvin instability is studied. (au).

4705 (CTH-IEFT-PP–1992-15) **CASINO, a code for simulation of charged particles in an axisymmetric Tokamak.** Dillner, Oe. Chalmers Univ. of Technology, Goeteborg (Sweden). Inst. for Electromagnetic Field Theory and Plasma Physics. [1992]. 38p. Order Number DE93608547. Source: OSTI; NTIS; INIS.

The present report comprises a documentation of CASINO, a simulation code developed as a means for the study of high energy charged particles in an axisymmetric Tokamak. The background of the need for such a numerical tool is presented. In the description of the numerical model used for the orbit integration, the method using constants of motion, the Lao-Hirsman geometry for the flux surfaces and a method for reducing the necessary number of particles is elucidated. A brief outline of the calculational sequence is given as a flow chart. The essential routines and functions as well as the common blocks are briefly described. The input and output routines are shown. Finally the documentation is completed by a short discussion of possible extensions of the code and a test case. (au).

4706 (CTH-IEFT-PP–1992-16) **Subcritical reactive drift wave turbulence.** Nordman, H.; Pavlenko, V.P.; Weiland, J. Chalmers Univ. of Technology, Goeteborg (Sweden). Inst. for Electromagnetic Field Theory and Plasma Physics. [1992]. 20p. Order Number DE93608569. Source: OSTI; NTIS; INIS.

The existence of self-sustained toroidal ηi mode turbulence below the instability threshold has been shown by mode coupling simulations. Significant transport and a tendency for long-wavelength condensation are observed. The subcritical behaviour is explained as a result of nonlinear interaction between modes of positive and negative energy by analytical calculation of the coupling factors. (20 refs.) (au).

4707 (DOE/ER/53145–T1) **Atomic calculations for application to the diagnostics of tokamak plasmas: Final report.** Feldman, U.; Seely, J.F.; Doschek, G.A. Naval Research Lab., Washington, DC (United States). E.O. Hulburt Center for Space Research. Oct 1990. 9p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AI05-83ER53145. Order Number DE93004136. Source: OSTI; NTIS; INIS; GPO Dep.

This report discusses the following topics: Atomic data and line intensities; analysis of PLT spectra; zeeman splitting of magnetic dipole transitions; and level populations in dense plasmas.

4708 (DOE/ER/53194–5) **[Nonlinear magnetohydrodynamics].** Dartmouth Coll., Hanover, NH (United States). [1992]. 5p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG02-85ER53194. Order Number DE93003241. Source: OSTI; NTIS; INIS; GPO Dep.

Theoretical predictions were compared with available data from JET on the threshold unstable MHD activity in toroidal confinement devices. In particular, questions arising as to Hartmans number and the selection of a kinematic viscosity are discussed.

4709 (DOE/ER/53212–198) **Theoretical reversed field pinch and tokamak studies: Progress report, November 1, 1991–June 15, 1992.** Wisconsin Univ., Madison, WI (United States). [1992]. 3p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG02-85ER53212. Order Number DE93002775. Source: OSTI; NTIS; INIS; GPO Dep.

In previous work, electrostatic fluctuations that couple the free energy sources of resistive interchange turbulence (resistive g mode) and resistivity gradient driven turbulence (Rippling mode) were studied analytically and numerically. Evaluation of the predicted fluctuation levels using realistic MST parameters and the best estimates of equilibrium profiles yielded levels that appeared to be too small to agree with experiment. This work calls into question the standard scenario in which g modes (or rippling modes) are presumed to govern edge transport and account for the high frequency fluctuation activity in the RFP.

4710 (DOE/ER/53225–T6) **Far infrared fusion plasma diagnostics: Task 3A, Progress report, FY 1990.** Luhmann, N.C. Jr.; Peebles, W.A. California Univ., Los Angeles, CA (United States). [1990]. 89p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG03-86ER53225. Order Number DE93002531. Source: OSTI; NTIS; GPO Dep.

Over the last several years, reflectometry has grown in importance as a diagnostic for both steady-state density Profiles as well as for the investigation of density fluctuations and turbulence. As a diagnostic for density profile measurement, it is generally believed to be well understood in the tokamak environment. However, its use as a fluctuation diagnostic is hampered by a lack of quantitative experimental understanding of its wavenumber sensitivity and spatial resolution. Several researchers, have theoretically investigated these questions. However, prior to the UCLA laboratory investigation, no group has experimentally investigated these questions. Because of the reflectometer's importance to the world effort in understanding plasma turbulence and transport, UCLA has, over the last year, made its primary Task IIIA effort the resolution of these questions. UCLA has taken the lead in a quantitative experimental understanding of reflectometer data as applied to the measurement of density fluctuations. In addition to this, work has proceeded on the design, construction, and installation of a reflectometer system on UCLA's CCT tokamak. This effort will allow a comparison between the improved confinement regimes (H-mode) observed on both the DIII-D and CCT machines with the goal of achieving a physics understanding of the phenomena. Preliminary investigation of a new diagnostic technique to measure density profiles as a function of time has been initiated at UCLA. The technique promises to be a valuable addition to the range of available plasma diagnostics. Work on advanced holographic reflectometry technique as applied to fluctuation diagnostics has awaited a better understanding of the reflectometer signal itself as discussed above. Efforts to ensure the transfer of the diagnostic developments have continued with particular attention devoted to the preliminary design of a multichannel FIR interferometer for MST.

4711 (DOE/ER/53236–T3) **High beta and second region stability analysis and ICRF edge modeling: Progress report, March 15, 1988–May 14, 1989.** Grumman Aerospace Corp., Princeton, NJ (United States). Corporate Research Center. [1989]. 28p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG02-86ER53236. Order Number DE93003774. Source: OSTI; NTIS; INIS; GPO Dep.

This report describes the tasks accomplished under Department of Energy contract #DE-FG02-86ER53236 in modeling the edge plasma-antenna interaction that occurs during Ion Cyclotron Range of Frequency (ICRF) heating. This work has resulted in the development of several codes which determine kinetic and fluid modifications to the edge plasma. When used in combination, these code predict the level of impurity generation observed in experiments on the experiments on the Princeton Large Torus. In addition, these models suggest improvements to the design of ICRF antennas. Also described is progress made on high beta and second region analysis. Code development for a comprehensive infernal mode analysis code is nearing completion. A method has been developed for parameterizing the second region of stability and is applied to circular cross section tokamas. Various studies for high beta experimental devices such as PBX-M and DIII-D have been carried out and are reported on.

4712 (GA-A–21041) **Bias-sustained shield plasma.** Staebler, G.M.; Hyatt, A.W.; Schaffer, M.J.; Mahdavi, M.A. General Atomics, San Diego, CA (United States). Sep 1992. 13p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC03-89ER51114. (CONF-9209181–2: International Atomic Energy Agency (IAEA) technical committee meeting on tokamak plasma biasing, Montreal (Canada), 8-10 Sep 1992). Order Number DE93001908. Source: OSTI; NTIS; INIS; GPO Dep.

Divertor biasing may provide a method for density and impurity control by enhancing the shielding efficiency of the scrape-off layer. The idea is to make the scrape-off plasma denser and thicker by heating it with a bias-driven current, and by inducing a radial E x B drift. If the bias is applied to flux surfaces at the outer edge of the usual scrape-off layer, a new layer of plasma can be added which is sustained by the bias-supplied power. A simple theoretical model will be presented which shows that there is a threshold condition which must be satisfied in order for the bias-heated plasma to be self-sustaining. The bias-sustained plasma must also be opaque enough to neutrals in order for it to be fueled by a gas puff, which means that it win serve as a shield to the core plasma against neutral impurities and hydrogen. Experiments performed on DIII-D have demonstrated both a modification of the central nickel impurity concentration and an increase in the ionization of hydrogen within the scrape-off layer due to biasing.

4713 (IC–92/253) **Computer simulation of energy profiles in a plasma focus device.** Sigalo, F.B. (International Centre for Theoretical Physics, Trieste (Italy)); Gholap, A.V. International Centre for Theoretical Physics, Trieste (Italy). Sep 1992. 17p. Order Number DE93608560. Source: OSTI; NTIS (US Sales Only); INIS.

The study of the dynamics of the plasma focus device has been treated to include the distribution profiles of kinetic energy, electrical energy and power input within the axial phase. The Snowplow model equation for plasma motion in one dimension and the equations for energies have been programmed for computer simulation. The distribution of the energies show strong dependence on the ratio of the periodic time of the external circuit to the transit time of the current sheath motion in the axial phase. (author). 15 refs, 7 figs.

4714 (IC–92/256) **Nonlinear radiation of waves at combination frequencies due to radiation-surface wave interaction in plasmas.** El Naggar, I.A. (Alexandria Univ. (Egypt). Dept. of Physics); Hussein, A.M.; Khalil, Sh.M. International Centre for Theoretical Physics, Trieste (Italy). Sep 1992. 8p. Order Number DE93608570. Source: OSTI; NTIS (US Sales Only); INIS.

Electromagnetic waves radiated with combination frequencies from a semi-bounded plasma due to nonlinear interaction of radiation with surface wave (both of P-polarization) has been investigated. Waves are radiated both into vacuum and plasma are found to be P-polarized. We take into consideration the continuity at the plasma boundary of the tangential components of the electric field of the waves. The case of normal incidence of radiation and rarefield plasma layer is also studied. (author). 7 refs.

4715 (IC–92/257) **Kinetic nonlinear electron-ion two stream instability in field-free isothermal plasma.** Khalil, Sh.M. (International Centre for Theoretical Physics, Trieste (Italy)); Sayed, Y.A. International Centre for Theoretical Physics, Trieste (Italy). Sep 1992. 8p. Order Number DE93608571. Source: OSTI; NTIS (US Sales Only); INIS.

A nonlinear dispersion relation is derived and solved for a 1-D electron-ion two-stream (Buneman) instability which excited in isothermal field-free plasma. The major nonlinear mechanism is the quasilinear modification of the background distribution functions. We take into consideration the effect of the pair Coulomb collisions. The methods used here to solve the Vlasov's kinetic equation may also be used to investigate other types of current micro-instabilities in plasma. (author). 7 refs.

4716 (INIS-BR–3035) **Influence of a cylindrical column of rotating plasma on stability.** Rossato, L.C. Centro Tecnico Aeroespacial, Sao Jose dos Campos, SP (Brazil). Inst. Tecnologico de Aeronautica. 1975 49p. (In Portuguese). Order Number DE93608572. Source: OSTI; NTIS (US Sales Only); INIS.

The kink instability of a cylindrical column of rotating plasma, liable to a perturbation of the form f (r) exp [i(m -kz) + wt], under a condition kr<<m, was studied. It was concluded that as we increase the rotation, the interval of possible instabilities decreases. When the speed of rotation in the outlines of the plasma is equal to the speed of Alfven we will surely have stability. (author).

4717 (INPE–5255) **1990's annual report of INPE's Plasma Associated Laboratory.** Instituto de Pesquisas Espaciais (INPE), Sao Jose dos Campos, SP (Brazil). Jun 1991. 42p. (In Portuguese). (PRP–158.). Order Number DE93608544. Source: OSTI; NTIS (US Sales Only); INIS.

This is the 1990's annual report of INPE's Plasma Associated Laboratory it contains information on current research developed at the laboratory including quiescent plasma, magnetized plasma,

plasma centrifuge, plasma and radiation (gyrotron), ionic propulsion, and toroidal plasma. (A.C.A.S.).

4718 (INPE–5256) **Magnetic diagnostics for the proto-eta Tokamak.** Ferreira, J.L.; Aso, Y.; Ueda, M.; Ferreira, J.G. Instituto de Pesquisas Espaciais (INPE), Sao Jose dos Campos, SP (Brazil). Apr 1991. 24p. (CONF-9005433–: US-Brazil Expert's Workshop on Spherical Torus Experiments, Sao Jose dos Campos (Brazil), 1-9 May 1990; PRE–1680.). Order Number DE93608552. Source: OSTI; NTIS (US Sales Only); INIS.

This work gives a general view of the magnetic diagnostics rat will be used in the Proto-Eta Tokamak. These diagnostics will be useful tools to measure currents, electric and magnetic fields involved in the plasma magnetic confinement. (author).

4719 (INPE–5257) **Characterization of a gyrotron cavity at 10 GHz.** Castro, P.J. de; Castro, J.J.B. de; Correa, R.A.; Andrade Nono, M.C. de. Instituto de Pesquisas Espaciais (INPE), Sao Jose dos Campos, SP (Brazil). Apr 1991. 9p. (PRE–1681.). Order Number DE93608553. Source: OSTI; NTIS (US Sales Only); INIS.

Experiments have been conducted to characterize a gyrotron cavity designed to operate in the Te_{021} mode at 10 GHz. Small holes were introduced into the cavity to couple in and detect the probing power. Evaluation of the loaded Q factor is based on bandwidth measurements whereas standing-wave electric field profile is determined by using perturbation techniques. Good agreement between measured and predicted values of resonant frequencies and Q factors for several fundamental TE modes is found. (author).

4720 (INPE–5384) **Plasma diffusion through multi dipole magnetic fields.** Ferreira, J.L. Instituto de Pesquisas Espaciais (INPE), Sao Jose dos Campos, SP (Brazil). Mar 1992. 26p. (PRE–1750.). Order Number DE93608548. Source: OSTI; NTIS (US Sales Only); INIS.

The diffusion of a cold plasma through multi dipole fields of a magnetic picket fence is presented. The ion diffusion and trapping is determined by electric potentials inside the multi dipole fields. The electron diffusion is regulated by an anomalous transport process driven by low frequency fluctuations inside the magnetic sheath. Particles drifting with velocities above the ion acoustic speed generates high amplitude turbulent waves responsible for an anomalous diffusion process. (author).

4721 (INPE–5403) **Post-doctoral research work developed at the National Institute for Fusion Science - Japan.** Ueda, M. Instituto de Pesquisas Espaciais (INPE), Sao Jose dos Campos, SP (Brazil). May 1992. 22p. (In Portuguese). (PRP–169.). Order Number DE93608554. Source: OSTI; NTIS (US Sales Only); INIS.

This is a research report report on the work developed at the National Institute for Fusion Science - Japan, involving study of Beam Emission Spectroscopy. It describes the use of a fast neutral lithium beam (8 KeV) to measure the density profile in a Compact Helical Device. (A.C.A.S.).

4722 (INT–250/PS) **Search for nuclear fusion reaction in the $^3He\mu d$ system.** Balin, D.V. (Leningrad Nuclear Physics Institute, Gatchina, (Russian Federation)); Baturin, V.N.; Chestnov, Yu.A. Institute of Physics and Nuclear Techniques, Cracow (Poland). Jun 1991. 20p. Order Number DE93608592. Source: OSTI; NTIS (US Sales Only); INIS.

An attempt is made to observe muon catalysis of the fusion reaction $d + {}^3He \rightarrow {}^4He + p$ in the $^3He\mu d$ system. High pressure ($\simeq$ 100 atm.) ionization chamber filled with a deuterium-^{3}He mixture at room temperature was exposed to the negative muon beam of the synchrocyclotron at the Leningrad Nuclear Physics Institute to detect ^{4}He + p signals. The analysis of the obtained charged particle energy spectra shows no evidence for this reaction at the level of $\lambda_f > 7 \times 10^7\ s^{-1}$ where λ_f is the fusion rate averaged over the angular momentum states of the $^3He\mu d$ system. Possibilities of further investigations are discussed. (author).

4723 (INT–254/PS) **Hyperfine stucture effects in the collisions of the 2s metastable muonic hydrogen with hydrogen atoms.** Mikhailov, A.I. (Leningrad Nuclear Physics Institute, Gatchina (Russian Federation)); Czaplinski, W.; Gula, A. Institute of Physics and Nuclear Techniques, Cracow (Poland). Jun 1991. 32p. Order Number DE93608593. Source: OSTI; NTIS (US Sales Only); INIS.

Cross sections for elastic and spin-flip scattering of metastable 2s muonic hydrogen atoms are calculated for the symmetric systems: $p\mu$+H, $d\mu$+D and $t\mu$+T. The calculations are performed in the two-level approximation of the adiabatic method with inclusion of Lamb shift and electron screening. Due to large polarizability of the 2s state, the obtained cross sections significantly exceeded their counterparts for the ground state muonic hydrogen. (author) PL9200295.

4724 (JET-R–(92)-05) **Mapping techniques for solving non-integrable Hamiltonian systems.** Montvai, A. (CRIP, Budapest (Hungary)); Finckenstein, K.G.F. von; Duechs, D.F. Commission of the European Communities, Abingdon (UK). JET Joint Undertaking. May 1992. 44p. Order Number DE93608545. Source: OSTI; NTIS (US Sales Only); INIS.

In the research area of hot plasma confinement by magnetic fields e.g. for controlled thermonuclear fusion, the detailed calculation of magnetic field lines is obviously of fundamental importance. Magnetic field lines are idealised flux tubes conserving the enclosed magnetic flux along their way. This is one of the reasons why B-field line equations can be recast in the form of a Hamiltonian system of equations. In general, the physically interesting sets of equations are non-linear and coupled. Traditional analytic methods for their solution are available only in very special cases. Therefore, this report is devoted to the numerical solution of such a system, i.e., slightly generalised, to the solution of initial value problems for sets of first order differential equations. Because the system described is in practice always non-linear analytic solutions can not be found in general. (author).

4725 (LRP–456/92, pp. 25) **Anisotropic pressure numerical 3D MHD equilibria.** Hirshman, S.P. (Oak Ridge National Lab., TN (United States)); Cooper, W.A.; Merazzi, S.; Gruber, R. Ecole Polytechnique Federale, Lausanne (Switzerland). Centre de Recherche en Physique des Plasma (CRPP). May 1992. (CONF-920610–: 14. international conference on plasma and 19th EPS conference on controlled fusion and plasma physics, Innsbruck (Austria), 29 Jun - 3 jul 1992). In *Papers contributed to the 19. EPS conference on controlled fusion and plasma physics.* vp. Order Number DE93000810. Source: OSTI; NTIS; INIS.

It is demonstrated that the minimisation of en energy functional can be used to determine three dimensional (3D) magnetohydrodynamic (MHD) equilibria with anisotropic pressure. 2 figs., 5 refs.

4726 (LRP–456/92, pp. 25) **Stabilization of axisymmetric modes and the effects of plasma deformability in elongated tokamak plasmas using active feedback coils inside and outside the vacuum vessel.** Ward, D.J. (Ecole Polytechnique Federale, Lausanne (Switzerland). Centre de Recherche en Physique des Plasma (CRPP)); Hofmann, F. Ecole Polytechnique Federale, Lausanne (Switzerland). Centre de Recherche en Physique des Plasma (CRPP). May 1992. (CONF-920610–: 14. international conference on plasma and 19th European Physical Society (EPS) conference on controlled fusion and plasma physics, Innsbruck (Austria), 29 Jun - 3 jul 1992). In *Papers contributed to the 19. EPS conference on controlled fusion and plasma physics.* [25] Order Number DE93000810. Source: OSTI; NTIS; INIS.

In this paper we study the feedback stabilization of the vertical instability in a highly elongated ($\kappa = 3$) TCV plasma using a combination of active coils inside and outside the vacuum vessel. The TCV is a tokamak under construction at the CRPP in Lausanne. It is designed to create plasmas with a variety of cross-sectional shapes with elongations up to $\kappa = 3$. We calculate axisymmetric stability using the NOVA-W code. It has been observed that the deformation of the eigenfunction plays a crucial role in the ability of the feedback system to successfully stabilize the plasma. It is important to understand the deformation of the eigenfunction resulting from a particular choice of active coils in order to choose an appropriate set of magnetic measurements to determine the vertical displacement. The use of internal and external active coils imposes a particular deformation that allows one to choose a small number of well placed measurements. A large number of magnetic measurements distributed around the plasma does not necessarily improve matters, and in fact can be much less effective than a

smaller number of well placed measurements. The deformation of the eigenfunction is also strongly affected by the distribution of currents in the external coils. (author) 3 figs., 3 refs.

4727 (PPPL–2855) **Particle balance in a TFTR supershot.** Budny, R.V.; Coster, D.; Stotler, D.; Bell, M.G.; Janos, A.C.; Owens, D.K. Princeton Univ., NJ (United States). Plasma Physics Lab. Nov 1992. 17p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC02-76CH03073. (CONF-920311–26: 10. international conference on plasma-surface interactions in controlled fusion devices, Monterey, CA (United States), 30 Mar - 3 apr 1992). Order Number DE93003289. Source: OSTI; NTIS; INIS; GPO Dep.

Particle balance has been studied self-consistently for a TFTR supershot during a relatively steady-state phase of the neutral beam injection. The TRANSP analysis code was used to model plasma parameters within the last closed flux surface, deriving time-dependent plasma profiles from measurements. The poloidal flux surfaces were obtained from TRANSP and an equivalent-filament analysis code. The edge plasma and recycling were modeled using the combined B2/DEGAS code with boundary conditions from the TRANSP modeling. The edge and scrape-off modeling results are compared with measurements of the $D\alpha$ emission and temperature increases in the inner limiter.

4728 (PPPL–2856) **Transport of energetic ions by low-n magnetic perturbations.** Mynick, H.E. Princeton Univ., NJ (United States). Plasma Physics Lab. Oct 1992. 37p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC02-76CH03073. Order Number DE93002633. Source: OSTI; NTIS; INIS; GPO Dep.

The stochastic transport of MeV ions induced by low-n magnetic perturbations is studied, focussing chiefly on the stochastic mechanism operative for passing particles in low frequency perturbations. Beginning with a single-harmonic form for the perturbing field, it iii first shown numerically and analytically that the stochastic threshold of energetic particles can be much lower than that of the magnetic field, contrary to earlier expectations, so that MHD perturbations could cause appreciable loss of energetic ions without destroying the bulk confinement. The analytic theory is then extended in a number of directions, to darity the relation of the present stochaistic mechanism to instances already found, to allow for more complex perturbations, and to consider the more general relationship between the stochasticity of magnetic fields, and that of particles of differing energies (and pitch angles) moving in those fields. It is shown that the stochastic threshold is in general a non-monotonic function of energy, whose form can to some extent be tailored to achieve desired goals (e.g., burn control or ash removal) by a judicious choice of the perturbation. Illustrative perturbations are exhibited which are stochastic for low but not for high-energy ions, for high but not for low-energy ions, and for intermediate-energy ions, but not for low or high energy. The second possibility is the behavior needed for burn control; the third provides a possible mechanism for ash removal.

4729 (PPPL-CFP–2755) **The relationship between turbulence measurements and transport in different heating regimes in TFTR.** Bretz, N.L. (Princeton Univ., NJ (United States). Plasma Physics Lab.); Mazzucato, E.; Nazikian, R.; Paul, S.F.; Hammett, G.; Rewoldt, G.; Tang, W.M.; Zarnstorff, M.C.; Fonck, R.J.; Durst, R.; Cosby, G. Princeton Univ., NJ (United States). Plasma Physics Lab. [1992]. 9p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC02-76CH03073. (CONF-920913–16: 14. international conference on plasma physics and controlled nuclear fusion research, Wuerzburg (Germany), 30 Sep - 7 oct 1992; IAEA-CN–56/A-7-17). Order Number DE93002101. Source: OSTI; NTIS; INIS; GPO Dep.

The scaling of broad band density fluctuations in the confinement zone of TFTR measured by microwave scattering, beam emission spectroscopy (BES), and reflectometry show a relationship between these fluctuations and energy transport measured from power balance calculations. In L-mode plasmas scattering and BES indicates that the density fluctuation level, δn^2, in the confinement zone for $0.2 < k_\perp ps < 1.0$ depends qualitatively on P_{aux} and I_p in a way that is consistent with variations in energy transport. Fluctuation levels measured with all systems increase strongly toward the edge in all heating regimes following increases in energy transport coefficients. Measurements using BES have shown that poloidal and radial correlation lengths in the confinement zone of L-mode and supershot plasmas fall in the range of 1 to 2 cm. with a wave structure which has $k_{max} \approx 1\ cm^{-1}$ ($k_\perp ps \approx 0.2$) in the poloidal direction and k_{max} approaching zero in the radial direction. A simple estimate of the diffusion coefficient based on a measured radial correlation length and correlation time indicates good agreement with power balance calculations. Similar estimates using reflectometry give radial coherence lengths at 10 to 20 kHz in low density ohmic and supershot plasmas of between I and 2 cm.

4730 (PPPL-CFP–2756) **Novel current drive experiments on the CDX-U, HIT, and DIII-D Tokamaks.** Ono, M. (Princeton Univ., NJ (United States). Plasma Physics Lab.); Forest, C.B.; Hwang, Y.S.; Armstrong, R.J.; Choe, W.; Darrow, D.S.; Greene, G.; Jones, T.; Jarboe, T.R.; Martin, A.; Nelson, B.A.; Orvis, D.; Painter, C.; Zhou, L.; Rogers, J.A.; Schaffer,Princeton Univ., NJ (United States). Plasma Physics Lab. [1992]. 8p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC02-76CH03073 ;FG06-90ER54095 ;AC03-89ER51114. (CONF-920913–17: 14. international conference on plasma physics and controlled nuclear fusion research, Wuerzburg (Germany), 30 Sep - 7 oct 1992; IAEA-CN–56/E-2-5). Order Number DE93002102. Source: OSTI; NTIS; INIS; GPO Dep.

Two types of novel, non-inductive current drive concepts for starting-up and maintaining tokamak discharges have been developed on the CDX-U, HIT, and DIII-D Tokamaks. On CDX-U, a new, non-inductive current drive technique utilizing fully internally generated pressure driven currents has been demonstrated. The measured current density profile shows a non-hollow profile which agrees with a modeling calculation including helicity conserving non-classical current transport providing the "seed current". Another current drive concept, dc-helicity injection, has been investigated on, CDX-U, HIT and DIII-D. This method utilizes injection of magnetic helicity via low energy electron currents, maintaining the plasma current through helicity conserving relaxiation. In these experiments, non-ohmic tokamak plasmas were formed and maintained in the tens of kA range.

4731 (PPPL-CFP–2757) **Electron ripple injection concept for transport control.** Choe, W.; Ono, M.; Hwang, Y.S. Princeton Univ., NJ (United States). Plasma Physics Lab. [1992]. 15p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC02-76CH03073. (CONF-9209181–3: International Atomic Energy Agency (IAEA) technical committee meeting on tokamak plasma biasing, Montreal (Canada), 8-10 Sep 1992). Order Number DE93002103. Source: OSTI; NTIS; INIS; GPO Dep.

Recent experiments in many devices have provided firm evidence that the edge radial electric field profile differs between L- and H-modes, and that these fields can greatly modify transport in tokamak plasmas. A nonintrusive method for inducing radial electric field based on electron ripple injection is being developed by the CDX-U group. This technique utilizes a pair of special coils to create a local magnetic field ripple to trap the electrons at the edge of the plasma. The trapped electrons then drift into the plasma due to the ∇B drift. An ECH power is applied to accelerate electrons to sufficient perpendicular energy to penetrate into the plasma. Application of ECH power to the trapped electrons should provide the desired 20 A of electron current with electrons of a few keV of energy and $v_\perp/v_\parallel \gg 1$. A controlled experiment to investigate the physics of ECH aided ripple injection has been designed on CDX-U. With the set of ripple coils designed for CDX-U, a ripple fraction of $\delta\ (= \nabla B/B_{av}) \sim 5\%$ is attainable. At this ripple fraction, electrons are trapped if $v_\perp/v_\parallel \gg 1 > (2\delta)^{\frac{-1}{2}} \approx 3$. A resonant cavity box was fabricated for efficient heating of the trapped electrons. It is also capable of measuring the effect of the field ripple in conjunction with trapped electrons. Some preliminary results are given.

4732 (PPPL-CFP–2758) **Emissive limiter bias experiment for improved confinement of tokamaks.** Choe, W. (Princeton Univ., NJ (United States). Plasma Physics Lab.); Ono, M.; Darrow, D.S.; Pribyl, P.A.; Liberati, J.R.; Taylor, R.J. Princeton Univ., NJ (United States). Plasma Physics Lab. [1992]. 19p. Sponsored by

USDOE, Washington, DC (United States). DOE Contract AC02-76CH03073 ;FG03-86ER53225. (CONF-9209181–4: International Atomic Energy Agency (IAEA) technical committee meeting on tokamak plasma biasing, Montreal (Canada), 8-10 Sep 1992). Order Number DE93002100. Source: OSTI; NTIS; INIS; GPO Dep.

Experiments have been performed in Ohmic discharges of the UCLA CCT tokamak with a LaB_6 biased limiter, capable of emitting energetic electrons as a technique to improve confinement in tokamaks. To study the effects of emitted electrons, the limiter position, bias voltage, and plasma position were varied. The results have shown that the plasma positioning with respect to the emissive limiter plays an important role in obtaining H-mode plasmas. The emissive cathode must be located close to the last closed flux surface in order to charge up the plasma. As the cathode is moved closer to the wall, the positioning of the plasma becomes more critical since the plasma can easily detach from the cathode and reattach to the wall, resulting in the termination of H-mode. The emissive capability appears to be important for operating at lower bias voltage and reducing impurity levels in the plasma. With a heated cathode, transition to H-mode was observed for $V_{bias} \leq 50$ V and $I_{inj} \geq 30$ A. At a lower cathode heater current, a higher bias voltage is required for the transition. Moreover, with a lower cathode heater current, the time delay for inducing H-mode becomes longer, which can be attributed to the required time for the self-heating of the cathode to reach the emissive temperature. From this result, we conclude that the capacity for emission can significantly improve the performance of limiter biasing for inducing H-mode transition. With L-mode plasmas, the injection current flowing out of the cathode was generally higher than 100 A.

4733 (SINS–2088/P-2/PL/A) **Search for a nuclear signature of the electrolytically induced cold fusion.** Wojtkowska, J. (Soltan Inst. for Nuclear Studies, Otwock-Swierk (Poland)); Glowacki, S.; Jaskola, M.; Moroz, Z.; Ratynski, W.; Kedzierzawski, P.; Zoltowski, P. Soltan Inst. for Nuclear Studies, Otwock-Swierk (Poland). Jan 1990. 14p. Order Number DE93608594. Source: OSTI; NTIS (US Sales Only); INIS.

The neutron flux from the Pd-Pt electrolytic cell filled with $D_2O+D_2SO_4$ and D_2O+LiOD was measured to search for the "cold fusion" induced in the deuterium stored in the palladium electrode. The fast-neutron "long counter", the scintillation detector with the NE - 213 liquid scintillator and with the PSD gamma-neutron distinguishing system and the scintillation detector of fast-neutron and/or gamma-ray bursts were used. No direct correlation was observed between the neutron flux measured in the presence or absence of the electrolysis. The upper limit is given for the neutron flux induced by the process under study. (author).

4734 (SINS–2103/P-5/PP/A) **Strong refraction effects at optical probing of high-density plasma.** Pawlowicz, W. Soltan Inst. for Nuclear Studies, Otwock-Swierk (Poland). Oct 1990. 17p. Order Number DE93608555. Source: OSTI; NTIS (US Sales Only); INIS.

Ray-crossing effect and importance of focusing accuracy at optical probing of strongly refracting,partially transparent objects, are discussed. Quantitative results obtained from exact formulas are given. Analysis was carried out under assumption of a refractive index field, characteristic of laser-driven plasmas, and within geometrical optics limits. (author).

4735 (SINS–2120/P-5/PP/A) **Validity of inverse Abel transformation at investigation of strongly refracting axisymmetric objects.** Pawlowicz, W. Soltan Inst. for Nuclear Studies, Otwock-Swierk (Poland). Aug 1991. 9p. (CONF-9110326–: European conference on laser interaction with matter (ECLIM), Warsaw (Poland), 21-25 Oct 1991). Order Number DE93608556. Source: OSTI; NTIS (US Sales Only); INIS.

Report received in March 1992.

Results of approximate (under assumption of weak refraction) Abel inverse transformation applied to refraction and optical path difference data calculated for strongly refracting axisymmetric electron density profiles are presented. Computer simulation has been carried out for exponential electron density distributions, which may be used to describe analytically an electron density profile of a laser-produced plasma. Parameters of these profiles were chosen to cover the range of experimentally observed electron density shapes when high power laser beam-plasma interaction is under investigation. The results, for two most commonly used probing radiation wavelengths 0.53 μm and 0.27 μm, are presented. It is concluded that, for the electron density profiles under investigation and for reasonable scale length factor values, inversion schemes of refraction and optical path difference data based on weak or negligible refraction assumption can work even if the strong refraction of the probing radiation occurs. (author).

4736 (UCRL-LR–110877) **Dielectronic recombination of highly charged ions using an electron beam ion trap.** DeWitt, D.R. Lawrence Livermore National Lab., CA (United States). 16 Jun 1992. 195p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. Order Number DE92041090. Source: OSTI; NTIS; GPO Dep.

Thesis submitted to University of California, Davis.

Dielectronic Recombination is an important electron-ion recombination process which affects many aspects of plasmas. This work presents experimental measurements of relative dielectronic recombination cross sections for three highly charged ions: hydrogenlike argon (Ar^{17+}), heliumlike argon (Ar^{16+}), and neonlike xenon (Xe^{44+}). The dielectronic recombination cross sections are compared to theoretical resonance strengths. Excellent agreement is found overall. The energy resolution of the experimental measurements is 18 eV FWHM. These experiments make use of the ion extraction system recently installed on the Electron Beam Ion Trap (EBIT). With this technique the interactions are measured through measurement of relative ion populations rather than relative x-ray intensities.

4737 (UW-CPTC–92-5) **Long wavelength magnetic fluctuations in toroidal plasmas.** Hegna, C.C.; Callen, J.D. Wisconsin Univ., Madison, WI (United States). Oct 1992. 7p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG02-86ER53218. (CONF-9207157–1: 1992 Cargese magnetic turbulence and transport workshop, Cargese (France), 6-12 Jul 1992). Order Number DE93002352. Source: OSTI; NTIS; INIS; GPO Dep.

Fluctuating bootstrap currents provide a mechanism for long wavelength electromagnetic fluctuations in tokamak plasmas. The existence of micro-magnetic islands may be responsible for the experimental observations of core density fluctuations. A fluctuation model is introduced for the tokamak that describes the magnetic topology as a time-varying mix of magnetic islands, stochastic zones and "good" magnetic surfaces.

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Refer also to citation(s) 3566, 3581, 3624, 4452, 4693, 4694, 4712, 4732

4738 (BNL–47989) **Nuclear fusion of protons with boron.** Ruggiero, A.G. Brookhaven National Lab., Upton, NY (United States). Sep 1992. 19p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC02-76CH00016. (CONF-9209103–1: European research conference on nuclear physics: prospects for heavy ion inertial fusion, Aghia Pelaghia (Greece), 27 Sep - 1 oct 1992). Order Number DE93001978. Source: OSTI; NTIS; INIS; GPO Dep.

Two methods are investigated in this paper to convert the released fusion energy directly in electric power. The first is very simply the use of a beam of protons traversing a fixed target of Boron. Unfortunately this method cannot be made to work, but its investigation naturally yields to the second method which makes use of two beams, one of protons and one of ions of Boron, colliding with each other. This second method is feasible but it requires a significant amount of research and development in accelerator technology.

4739 (CONF-921116–5) **Depth profiling of deuterium using nuclear reaction analysis.** Hughes, I.G. (Oak Ridge National Lab., TN (United States)); Behrisch, R.; Martinelli, A.P. Oak Ridge National Lab., TN (United States). [1992]. 13p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. From 12. international conference on the application of accelerators in research and industry; Denton, TX (United

States); 2-5 Nov 1992. Order Number DE93002341. Source: OSTI; NTIS; INIS; GPO Dep.

We report on a method to measure the depth profile of deuterium up to a depth of 7μm in a carbon | beryllium layer using the D(^{3}He,p)^{4}He nuclear reaction in a resonance like technique. The deuterium depth profile is determined from a measurement of the proton yield as a function of incident ^{3}He ion energy for a limiter tile from the Joint European Torus (JET) Tokamak.

4740 (DOE/ER/51069–T2) **Advanced Limiter Test-II Program to field a toroidal belt pump limiter in the TEXTOR tokamak: Progress report, FY 1985.** Conn, R.W.; Goebel, D.M. California Univ., Los Angeles, CA (United States). [1985]. 23p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG03-85ER51069. Order Number DE93004139. Source: OSTI; NTIS; GPO Dep.

During the first quarter, the UCLA members of the ALT-II team worked primarily on the development of the experimental program plan and the diagnostics selection, and on the data acquisition system. These programs are discussed in this report.

4741 (DOE/ER/51069–T5) **ALT-II progress report and proposal, December 1989–December 1990.** California Univ., Los Angeles, CA (United States). [1989]. 4p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG03-85ER51069. Order Number DE93004142. Source: OSTI; NTIS; INIS; GPO Dep.

The Advanced Limiter Test (ALT-11) is a joint international program among the United States, the Federal Republic of Germany, and Japan to investigate the performance of a toroidal belt pump limiter in a tokamak, to investigate the behavior of the plasma edge, and to relate edge behavior to overall core energy and particle confinement. The experiments are carried out in the TEXTOR tokamak at KFA Juelich, Federal Republic of Germany. The ALT-II experiment was installed in TEXTOR in 1987 with the objectives of optimizing plasma performance in a limiter tokamak, and of studying the physics of particle removal, density and impurity control, and confinement enhancement by a toroidal belt pump limiter. The ALT-II program addresses large area limiter tokamak operation issues by providing a program specifically directed toward plasma optimization and particle and impurity control by a toroidal belt limiter in a machine dedicated to the investigation of plasma-wall interactions. TEXTOR features the most advanced set of edge plasma diagnostics of any tokamak for the task of diagnosing and understanding the impact of the limiter on the plasma confinement and performance. With the addition of 3.4 MW of neutral beam injection heating (NBI) to the existing 4 MW of ion cyclotron resonance heating (ICRH), TEXTOR also provides power densities equivalent to larger tokamaks.

4742 (DOE/ER/51069–T6) **ALT-II program progress report for FY92.** California Univ., Los Angeles, CA (United States). 26 May 1992. 4p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG03-85ER51069. Order Number DE93004143. Source: OSTI; NTIS; INIS; GPO Dep.

In FY92, the ALT-II program is concentrating on three main physics areas: pumped limiter experiments, which include He exhaust and high density high power operation; limiter bias experiments focused on modifying edge transport and particle removal; and and edge transport and flow studies, which examine the equilibrium edge flows and transport physics during Ohmic, L-mode, Supershot, and H-mode confinement regimes. In support of these physics objectives, a CCD diagnostic system has been delivered to TEXTOR and is being used to supplement the previous ALT-II diagnostic system. A second fast-scanning Langmuir probe was constructed at UCLA and has been delivered to TEXTOR for use in studies of edge plasma flows, turbulent transport, and poloidal asymmetries. A brief synopsis of each topic is given below. Work will continue on these physics topics during the balance of FY92.

4743 (DOE/ER/52124–T2) **Fusion neutronics experiments and analysis: Progress report, November 1, 1991–October 31, 1992.** California Univ., Los Angeles, CA (United States). [1992]. 19p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG03-86ER52124. Order Number DE93003266. Source: OSTI; NTIS; INIS; GPO Dep.

UCLA has led the neutronics R&D effort in the US for the past several years through the well-established USDOE/JAERI Collaborative Program on Fusion Neutronics. Significant contributions have been made in providing solid bases for advancing the neutronics testing capabilities in fusion reactors. This resulted from the hands-on experience gained from conducting several fusion integral experiments to quantify the prediction uncertainties of key blanket design parameters such as tritium production rate, activation, and nuclear heating, and when possible, to narrow the gap between calculational results and measurements through improving nuclear data base and codes capabilities. The current focus is to conduct the experiments in an annular configuration where the test assembly totally surrounds a simulated line source. The simulated line source is the first-of-a-kind in the scope of fusion integral experiments and presents a significant contribution to the world of fusion neutronics. The experiments proceeded through Phase IIIA to Phase IIIC in these line source simulation experiments started in 1989.

4744 (DOE/ER/52158–3) **Tokamak reactor systems studies: Progress report, November 1, 1991–October 31, 1992.** Wisconsin Univ., Madison, WI (United States). Fusion Technology Inst. 27 Aug 1992. 5p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG02-89ER52158. Order Number DE93004639. Source: OSTI; NTIS; INIS; GPO Dep.

A summary of work completed on the ARIES project during this report period is given. The main areas of effort were: neutronics, shield optimization and design, safety, systems, startup and shutdown, and ripple loss. (MOW)

4745 (EGG-FSP–10323) **Secondary Containment System component failure data analysis from 1984 to 1991.** Cadwallader, L.C. (EG and G Idaho, Inc., Idaho Falls, ID (United States)); Sanchez, D.P. EG and G Idaho, Inc., Idaho Falls, ID (United States). Aug 1992. 66p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC07-76ID01570. Order Number DE93001928. Source: OSTI; NTIS; INIS; GPO Dep.

This report gives the failure rates for the major tritium containing glovebox systems that comprise the Secondary Containment System at the Tritium systems Test Assembly, which is a fusion research and technology facility at the Los Alamos National Laboratory. The component failure reports, the numbers of components, and operating times or demands are all given in this report, and sample calculations of the binomial demand failure rates and poisson hourly failure rates are given in the appendices. The failure rates for these components form a solid data point based on actual operating experience, where there is very little published information. The eight years of nearly continuous Secondary Containment System operations should result in steady state failure rate values. These data should be useful for future fusion reactor design work and safety assessment tasks.

4746 (EGG-FSP–10396) **Exploratory study of burn time, duty factor, and fluence on ITER activation hazards.** Piet, S.J. EG and G Idaho, Inc., Idaho Falls, ID (United States). Aug 1992. 70p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC07-76ID01570. Order Number DE93001921. Source: OSTI; NTIS; INIS; GPO Dep.

The safety analyses for the Conceptual Design Activity (CDA) of the International Thermonuclear Experimental Reactor (ITER) were based on the simplifying assumption that the activation of materials occurs continuously. Since the analyses showed a significant hazard, it is appropriate to examine how much hazard reduction might occur if this conservative assumption were relaxed. This report explores how much reduction might be gained by considering non-continuous operation, that is, by considering plasma burn time, duty factor, and integrated fluence. Other factors impacting activation hazards - material choice, flux, and size - are not considered here.

4747 (GA-A–21016) **Design and analysis of the cryopump for the DIII-D advanced divertor.** Reis, E. (General Atomics, San Diego, CA (United States)); Almajan, I.; Baxi, C.B.; Schaffer, M.J.; Sevier, D.L.; Smith, J.P.; Menon, M.M. General Atomics, San Diego, CA (United States). Sep 1992. 5p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC03-89ER51114. (CONF-920930–7: 17. symposium on fusion technology, Rome

(Italy), 14-18 Sep 1992). Order Number DE93001357. Source: OSTI; NTIS; INIS; GPO Dep.

A cryocondensation pump for the DIII-D advanced diverter program is to be installed in the vacuum vessel in the fall of 1992. The purpose of the cryopump is to remove gas from the diverter, reduce recycling to the plasma, and to provide reduced density plasmas for experimental study. The pump is designed for a pumping speed of 50,000 l/s at 0.4 mtorr. The major pump components are toroidally continuous to minimize inductive voltages, thereby greatly reducing the risk of any electrical breakdown during disruptions. The cryopump consists of a 25mm Inconel tube, 10m long, cooled by liquid helium. It is surrounded by liquid nitrogen-cooled shields and a segmented ambient temperature radiation/particle shield. The outer nitrogen shield has a toroidally discontinuous copper coating to enhance thermal conductivity while maintaining a high toroidal electrical resistance to minimize electromagnetic loads during disruptions. The pump is cooled by 10 g/s of liquid helium at an inlet pressure of 115 kPa and temperature of 4.35 K. The pump is subjected to a steady-state heat load of <10 W due to conduction and radiation heat transfer. The helium tube will be subjected to Joule heating of <182J due to induced current and a particle load of <20 W during plasma operation. Thermal analysis and tests show that the helium tube can absorb a transient heat load of up to 100 W for 10s and still pump deuterium at 6.3 K.

4748 (GA-A–21036) **New DIII-D tokamak plasma control system.** Campbell, G.L. (General Atomics, San Diego, CA (United States)); Ferron, J.R.; McKee, E.; Nerem, A.; Smith, T; Greenfield, C.M.; Pinsker, R.I.; Lazarus, E.A. General Atomics, San Diego, CA (United States). Sep 1992. 5p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC03-89ER51114. (CONF-920930–5: 17. symposium on fusion technology, Rome (Italy), 14-18 Sep 1992). Order Number DE93000877. Source: OSTI; NTIS; INIS; GPO Dep.

A state-of-the-art plasma control system has been constructed for use on the DIII-D tokamak to provide high speed real time data acquisition and feedback control of DIII-D plasma parameters. This new system has increased the precision to which discharge shape and position parameters can be maintained and has provided the means to rapidly change from one plasma configuration to another. The capability to control the plasma total energy and the ICRF antenna loading resistance has been demonstrated. The speed and accuracy of this digital system will allow control of the current drive and heating systems in order to regulate the current and pressure profiles and diverter power deposition in the DIII-D machine. Use of this system will allow the machine and power supplies to be better protected from undesirable operating regimes. The advanced control system is also suitable for control algorithm development for future machines in these areas and others such as disruption avoidance. The DIII-D tokamak facility is operated for the US Department of Energy by General Atomics Company (GA) in San Diego, California. The DIII-D experimental program will increase emphasis on rf heating and current drive in the near future and is installing a cryopumped divertor ring during the fall of 1992. To improve the flexibility of this machine for these experiments, the new shape control system was implemented. The new advanced plasma control system has enhanced the capabilities of the DIII-D machine and provides a data acquisition and control platform that promises to be useful far beyond its original charter.

4749 (JET-R–(92)-04) **Review of NB_3 SN magnets completed or under manufacture and relevant for future fusion magnets.** Poehlchen, R. Commission of the European Communities, Abingdon (UK). JET Joint Undertaking. May 1992. 23p. Order Number DE93608604. Source: OSTI; NTIS (US Sales Only); INIS.

Nb_3Sn magnets make use of a forced flow of helium in the longitudinal direction through the individual conductor. The well established vacuum-pressure-impregnation process can be employed in order to achieve a mechanically monolithic winding pack with a highly reliable electric insulation with a high electric strength of 20 KV and above. This is of crucial importance for the Poloidal Coils in normal operation already, but even more important in case of a fast discharge of the Poloidal Coil system or the Toroidal Coil system. The higher the acceptable dump voltage is, the faster the discharge can be thus, making it easier to keep hot spot temperatures at acceptable levels. (author).

4750 (KFK–5045) **Report of results and of research and development work at the Institute of Technical Physics 1991.** Kernforschungszentrum Karlsruhe GmbH (Germany). Inst. fuer Technische Physik. Mar 1992. 45p. (In German). Order Number DE93729064. Source: OSTI; NTIS (US Sales Only); INIS.

The central areas of work are superconductivity and its applications, cryo-technology and microwave technology. The main point of technical development is the construction of magnets for the nuclear fusion project NET/ITER. Basic investigations concern low temperature and superconductor materials such as $YBa_2Cu_3O_{7-x}$ single crystals. (DG).

4751 (KFK–5059) **Preliminary safety assessment of the NET magnet system.** Kramer, W.; Meyder, R.; Raff, S.; Juengst, K.P.; Kronhardt, H. Kernforschungszentrum Karlsruhe GmbH (Germany). Inst. fuer Reaktorsicherheit; Kernforschungszentrum Karlsruhe GmbH (Germany). Inst. fuer Technische Physik; Kernforschungszentrum Karlsruhe GmbH (Germany). Projekt Kernfusion. Aug 1992. 75p. Order Number DE93729165. Source: OSTI; NTIS (US Sales Only); INIS.

After a characterization of the magnet system for the conceptual design of ITER previous failures of superconducting magnets are briefly reviewed. Possible accidents are discussed leading to the definition of so-called reference accident sequences. Since the magnet system does not contain significant radioactivity inventories the large stored energies are considered mainly to have the potential to initiate or enhance accidents. Of most concern are those events having a potential to propagate from the magnet system to adjacent radioactivity confining components. In this sense, the following events are considered to have a potential of failure propagation: (1) Uncontrolled growing of a normal conduction zone, (2) shorts and arcs outside and inside a coil, (3) coil deformation or displacement, and (4) volume change of cryogenic helium. The main part deals with the assessment of items (1) to (3), this means in detail thermal failures, the behaviour of shorts and arcs, and the mechanical consequences of electrical faults. (orig./HP).

4752 (LBL–32213) **ILSE: The next step toward a heavy Ion induction accelerator for inertial fusion energy.** Fessenden, T. (Lawrence Berkeley Lab., CA (United States)); Bangerter, R.; Berners, D.; Chew, J.; Eylon, S.; Faltens, A.; Fawley, W.; Fong, C.; Fong, M.; Hahn, K.; Henestroza, E.; Judd, D.; Lee, E.; Lionberger, C.; Mukherjee, S.; Peters, C.; Pike, C.; RaymLawrence Berkeley Lab., CA (United States). Jul 1992. 10p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC03-76SF00098. (HIFAN–538;IAEA-CN–56/B-2-3;CONF-920913–15: 14. international conference on plasma physics and controlled nuclear fusion research, Wuerzburg (Germany), 30 Sep - 7 oct 1992). Order Number DE93000345. Source: OSTI; NTIS; INIS; GPO Dep.

LBL and LLNL propose to build, at LBL, the Induction Linac Systems Experiments (ILSE), the next logical step towards the eventual goal of a heavy-ion induction accelerator powerful enough to implode or "drive" inertial-confinement fusion targets. ILSE, although much smaller than a driver, will be the first experiment at full driver scale in several important parameters. Most notable among these are line charge density and beam cross section. Many other accelerator components and beam manipulations needed for an inertial fusion energy (IFE) driver will be tested. The ILSE accelerator and research program will permit experimental study of those beam manipulations required of an induction linac inertial fusion driver which have not been tested sufficiently in previous experiments, and will provide a step toward driver technology.

4753 (PNL-SA–20872) **BEATRIX-II: In situ tritium recovery from Li_2O and Li_2ZrO_3 irradiated in a fast neutron flux.** Slagle, O.D. (Pacific Northwest Lab., Richland, WA (United States)); Hollenberg, G.W.; Kurasawa, T.; Verrall, R.A. Pacific Northwest Lab., Richland, WA (United States). Sep 1992. 6p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. (CONF-920930–12: 17. symposium on fusion technology, Rome (Italy), 14-18 Sep 1992). Order Number DE93001560. Source: OSTI; NTIS; INIS; GPO Dep.

The BEATRIX-II irradiation experiment was an in situ, fast neutron, tritium release experiment to evaluate the performance of ceramic fusion solid breeders at extended burnups. The experiment consisted of two sequential irradiations: Phase I for 300 EFPD and Phase II for 200 EFPD that resulted in lithium burnups from 4–6%. Thin-walled Li_2O ring specimens capable of temperature changes were irradiated in both Phase I and Phase II. Temperature changes were also used to determine the tritium inventory and to characterize the effect or irradiation history and sweep gas composition. Solid-cylindrical temperature-gradient specimens were irradiated to characterize their stability with respect to heat transport, lithium transport and physical integrity over the duration of the experiment. Phase I included a solid monolithic specimen of Li_2O while Phase II included a sphere bed of Li_2ZrO_3.

4754 (SAIC–92/1230) **ICRF antenna modeling and simulation: Final report.** Ho, Y.L.; Riyopoulos, S.; Grossmann, W. Science Applications International Corp., San Diego, CA (United States). 7 Dec 1992. 30p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC03-88ER53270. Order Number DE93004604. Source: OSTI; NTIS; INIS; GPO Dep.

ICH is a central element in all current and planned large tokamak experiments. In addition to its potential role as a primary heating source, ICH is also useful for equilibrium profile control and sawteeth stabilization. Optimization of ICRF antenna performance for either heating or current drive depends critically on the complex balance and interplay between the plasma physics and the electromechanical system requirements. For example, antenna designs and operational modes that minimize impurity production and induced sheath formation may, however, degrade current drive efficiency. Such effects have been observed in experiments involving π versus zero antenna phasing. Solutions to these kinds of technical problems – especially important for a reactor grade antenna where survivability becomes a key issue – require an integration of theory, numerically aided design through modeling and simulation, and experimental investigations. SAIC's efforts in helping to formulate approaches to address the above issues have focussed on two interdependent plasma physics areas: numerical modeling and simulation of ICRF antenna performance including antenna-plasma coupling, and sheath physics in the neighborhood of antennas with emphasis upon Faraday shield and cur-rent strap sheaths. The main goals of our work are to: provide a predictive capability for evaluating antenna performance, including radiated field and power spectral distributions, plasma/antenna coupling, develop an improved understanding of sheath physics phenomenology in the vicinity of ICRF antennas, particularly in the low edge densities where 2-D effects are fundamental, and incorporate the microscopic sheath effects into the macroscopic plasma/antenna performance predictions. These goals have helped SAIC to formulate an approach to the development of a modeling and simulation environment in which the important technical questions affecting ICH can be analyzed and evaluated.

4755 (UCLA/PPG–1323-Vol.1) **The ARIES-I tokamak reactor study: Volume 1, final report.** ARIES Collaborations. California Univ., Los Angeles, CA (United States). Inst. of Plasma and Fusion Research. 1991. 115p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG03-86ER52126 ;W-31109-ENG-38 ;AC03-89ER52153 ;AC07-76ID01570 ;W-7405-ENG-36 ;FG02-91ER54110 ;AC02-76CH03073 ;FG0 Order Number DE93002184. Source: OSTI; NTIS; INIS; GPO Dep.

This report discusses the following topics on the Aries-I Tokamak: Design description; systems studies and economics; reactor plasma physics; magnet engineering; fusion-power-ore engineering; and environmental and safety features.

4756 (UCRL-LR–109207) **Low-density foam materials from styrene-divinylbenzene inverse emulsions: Final report.** Cook, R.C.; Overturf, G.E. III; Haendler, B.L.; Kong, Fung-Ming; Letts, S.A. Lawrence Livermore National Lab., CA (United States). 4 Jul 1992. 15p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. Order Number DE93002854. Source: OSTI; NTIS; GPO Dep.

This report documents the research and development work conducted by the Materials Research and Production Group of the LLNL ICF Program's Special Projects Group between 1985 and 1989. A foam material composed of heavily cross linked polystyrene-divinylbenzene was prepared from an inverse emulsion of the monomers in water. Final foam densities as low as 25mg/cm^3 were obtained; cell sizes were not greater than 2 to 3 μm. This report documents procedures and characterization of the final material.

4757 (UCRL-LR–110935) **Ultraviolet SO lasers optically pumped by a tunable, line-narrowed KrF laser.** Stuart, B.C.D. Lawrence Livermore National Lab., CA (United States). Jun 1992. 230p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. Order Number DE93001624. Source: OSTI; NTIS; INIS; GPO Dep.

Thesis submitted to University of California, Davis.

The feasibility of an ultraviolet energy storage laser based on the long-lived sulfur monoxide $A^3\pi$-$\chi^3\Sigma^-$ electronic transition was investigated, and an ultraviolet laser based on the short-lived SO($B^3\Sigma^-$-$\chi^3\Sigma^-$) transition was demonstrated and modeled. Both were optically pumped by a continuously tunable, line-narrowed KrF laser developed for efficient rotationally resolved excitation of SO. SO was produced by both microwave discharge and excimer laser photolysis of the precursor molecules SO_2 and $SOCl_2$, with a maximum SO concentration (10^{16} cm^{-3}) generated by ArF (193 nm) photodissociation of SO_2. Laser induced fluorescence of SO was used to study the excitation spectroscopy, vibrational branching ratios, lifetimes and deactivation rates. The radiative lifetime of SO($A^3\pi_2$,v′ = 5) was measured to be 6.9 μs and that of SO(B,v′ = 1) to be 33 ns. Lifetimes in the highly perturbed SO(B,v′ = 2) level ranged from 28–90 ns. Measurements and modeling of the excitation saturation fluence as a function of buffer gas pressure determined what fraction of the ground state SO(X) molecules could be excited to SO(A) or SO(B). No evidence of excited state absorption was seen. Lasing on six new ultraviolet SO(B-X) vibrational bands in the range 262–315 nm was demonstrated. SO(B-X) pulse energies of up to 11 μJ were obtained and the gain coefficient was estimated to be 0.1 cm^{-1}. A multi-level rate equation model of the SO(B-X) excitation and lasing transitions, including collisional rotational mixing, described the dynamics of the lasing and measured output very well. Modeling showed and experiments confirmed that the maximum possible SO laser gain simply corresponded to saturating the excitation of a single rotational level. Collisional coupling of the rotational levels increased the laser output energy.

99 GENERAL AND MISCELLANEOUS

Refer also to citation(s) 2845

4758 (BNL–47744) **Tools for a career in science.** Mazurek, M.A. Brookhaven National Lab., Upton, NY (United States). May 1992. 4p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC02-76CH00016. (CONF-9205263–1: 17. Suffolk County Science Teachers Association awards, Smithtown, NY (United States), 20 May 1992). Order Number DE93001980. Source: OSTI; NTIS; GPO Dep.

The five fundamental tools for a scientist: (1) technical ability; (2) integrity; (3) initiative and self-motivation; (4) creativity; and, (5) persistence. Examples are given as to why each of these attributes are significant. This report was presented at the banquet for outstanding science awards winner.

4759 (CONF-9209213–1) **Present status and future directions of IRP.** Bauer, D.C. Oak Ridge National Lab., TN (United States). [1992]. 22p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400 ;AC03-76SF00098. From Forecasting and planning process; Kansas City, MO (United States); 22 Sep 1992. Order Number DE92041017. Source: OSTI; NTIS; GPO Dep.

Integrated Resource Planning or IRP is the process by which supply- and demand-side options are consistently planned, implemented, and evaluated to provide energy services at a cost that appropriately balances the interests of all stakeholders. This paper provides a status report on IRP as it is practiced today and then suggests how IRP is transforming itself to pursue new objectives in a changing energy and competitive landscape. The dimensions of

this transformation suggest the immediate "future directions" for IRP. In addition, a final section of our paper pushes through the immediate transformation of IRP within the energy context to speculate about possible application of the IRP principles to other contemporary issues. To establish the basis for this speculation, we posit several defining features that appear to be prerequisites for IRP-type processes to be successful. Some, or even a substantial number of these features may be absent in other settings. Their absence, in turn, should engender caution in those who might otherwise be enthusiastic about the application of "IRP Principles" to other resource allocation issues.

4760 (DOE/ER/75609–T1) **Impact of the FUTURES series: Executive summary.** Research Communications Ltd., Dedham, MA (United States); Foundation for Advancements in Science and Education (FASE), Los Angeles, CA (United States). Apr 1992. 41p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG05-91ER75609. Order Number DE93004364. Source: OSTI; NTIS; GPO Dep.

The purpose of this study was to evaluate the effectiveness of the FUTURES series in affecting junior high school students' attitudes towards math and careers. FUTURES is a series of 12 programs designed to encourage positive attitudes in students towards math and science. The series illustrates their relevance to a variety of careers. The programs are hosted by Jaime Escalante and targeted to seventh to 12th grade students, with a special focus on minority students. This study looked at the long-term effects of the FUTURES series under classroom conditions. This study was designed to measure the effectiveness of the series in: (1) increasing positive attitudes toward math and science in school; (2) motivating students to have more positive attitudes about their future careers; (3) widening the possible choices of careers that involve the use of math and science; and, (4) creating an understanding of the relevance of math and science to careers and daily life. In addition, this study examined the appeal of the series, the students' understanding of program content, and how the series was used in the classroom.

4761 (GKSS–92/E/1) **GKSS scientific and technical reports 1991.** GKSS-Forschungszentrum Geesthacht GmbH, Geesthacht-Tesperhude (Germany). 1992. 72p. (In German). Order Number DE93728955. Source: OSTI; NTIS (US Sales Only); INIS.

The following review contains - arranged by the main field of research - authors and titles of external GKSS reports published in 1991. Abstracts and bibliographical data are presented with the exception and reprints from journal articles, proceeding papers, and from contributions to monographs. (orig.).

4762 (INIS-mf–14085) **Current environmental situation in the new Federal States. Pt. 1.** Journalistenseminar der Information Umwelt. Haury, H.J. (GSF - Forschungszentrum fuer Umwelt und Gesundheit GmbH, Neuherberg (Germany). Projekt Information Umwelt); Koller, U.; Assmann, G. GSF - Forschungszentrum fuer Umwelt und Gesundheit GmbH, Neuherberg (Germany). May 1992 144p. (In German). (CONF-9112144–: Press seminar of the GSF Project 'Information Environment', Berlin (Germany), 3-4 Dec 1991). Order Number DE93728679. Source: OSTI; NTIS (US Sales Only); INIS.

'Information on Environment' organised the first part of a seminar for jounalists on the present environmental situation in the now federal states in Berlin on the 3rd and 4th of December. More than 50 participants from radios, TV, daily and special press attended this ninth event of 'Information on Environment' in Berlin. Leading scientists from research institutes of the former GDR, the Federal Environmental Agency and the GSF-research centre for environment and heath gave papers on the predominant environmental problems in the new federal states. This first part deals with water pollution, waste water treatment, drinking water supply, environmental problems of lignite mining, radiation pollution in the Erzgebirge; forest damage research and special armament wastes and waste problems in general. (orig.).

4763 (ORNL/TM–12145) **Technology in education: A guidebook for developing a science and math education support program.** Wagner, C.L. Oak Ridge National Lab., TN (United States). Sep 1992. 122p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. Order Number DE93003660. Source: OSTI; NTIS; GPO Dep.

Education is vital to survival and success in an increasingly technical world, and the quality of education is the responsibility of everyone students, teachers, parents, industry, and government. Any technical organization wanting to contribute to that success through its local education system can do so easily and effectively through careful planning. This report details that planning process and includes methods to (1) identify the interests, strengths, and resources of the technical organization; (2) identify the needs of the local education system; (3) interface with local school system administration, principals, and teachers; and (4) develop a unique plan to match the organization's strengths and resources with the needs of the school system. Following these "getting started" activities is the actual program that the Engineering Technology Division implemented in a local elementary school, including the curriculum, topics, and actual lesson plans used by technical personnel in the classroom. Finally, there are enrichment activities for teachers and students, suggestions for measuring the success of an education support program, and an overview of student responses to questions about the overall program.

4764 (PNL-SA–20881) **Implications for education and training programs of the ER/WM workforce assessment.** Lewis, R.E.; Holmes, C.W. Pacific Northwest Lab., Richland, WA (United States). Aug 1992. 9p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. (CONF-920851–74: Spectrum '92: nuclear and hazardous waste management international topical meeting, Boise, ID (United States), 23-27 Aug 1992). Order Number DE92041331. Source: OSTI; NTIS; GPO Dep.

Assessments of the supply and demand for scientific, engineering, and technical occupations relevant to the Environmental Management (EM) organization were conducted by examining budget projections and the input of managers throughout the DOE complex. Managers feel the complex faces a large percentage increase in the number of individuals who will be employed in environmental restoration and waste management activities over the 1993-1997 timeframe. They do not, however, feel that the skills mix of occupations will change markedly. Selected "niche" occupations will be difficult to staff but training and education options exist to ease shortages.

9901 Management

Refer also to citation(s) 2738, 2840, 2841, 2847, 3031, 3155, 3162, 3163, 3164, 3167, 3295, 3297, 3460, 3481, 3548, 3905, 4355, 4365, 4815

4765 (DOE/NP/00119–2-Vol.1) **Research and development of post classical management tools for government program offices: Second technical progress report, November 1990–April 1992: Volume 1.** Virginia Polytechnic Inst. and State Univ., Blacksburg, VA (United States). May 1992. 52p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG02-91NP00119. Order Number DE93004124. Source: OSTI; NTIS (US Sales Only); GPO Dep.

Subject is management of large government programs, with particular application to nuclear industry and new production reactors. The Grand Strategy System hypothesizes that by successfully managing each of eight fronts in an integrated and coordinated fashion, the ultimate success of a program can be ensured. These 8 fronts are: culture; infrastructure (administration); planning; measurement; education, training and development; motivation; politics; and technology.

4766 (INIS-BR–3053) **The nuclear controversy in relations between Brazil and United Stated of America.** Wrobel, P.S. Instituto Universitario de Pesquisas do Rio de Janeiro, RJ (Brazil). 1986 168p. (In Portuguese). Order Number DE93608132. Source: OSTI; NTIS (US Sales Only); INIS.

The purpose of this research is to detach the nuclear controversy in relations between Brazil and United States of America in order to understand in the historical perspective. (C.M.).

4767 (INIS-GB–449) **Annual report and accounts 1991-92.** Scottish Nuclear Ltd., Glasgow (United Kingdom). 1992 51p. Order Number DE93608133. Source: OSTI; NTIS (US Sales Only); INIS.

The 1991-1992 Annual Report of Scottish Nuclear Limited includes a brief company profile. Scottish Nuclear, a company owned by the Secretary of State for Scotland, produces over forty per cent of Scotland's total electricity requirement from its Advanced Gas-Cooled Reactors at Hunterston and Torness. The Chairman's Report focuses an operational performance, improvements to public relations procedures and environmental concerns. The Report concludes with the Annual Accounts. (UK).

4768 (INIS-GB–450) **AEA Technology safety report 1990.** AEA Technology, London (United Kingdom). Dec 1991 17p. Order Number DE93608134. Source: OSTI; NTIS (US Sales Only); INIS.

AEA Technology is the trading name of the United Kingdom Atomic Energy Authority. Work in support of nuclear power at home and abroad continues to be an important part of our business but as nuclear power has matured AEA Technology has looked beyond its traditional role to other markets worldwide. We are a major commercial enterprise, with an annual turnover of Pound 450 million, selling a variety of technical services and products to customers worldwide. The scope of the business lies in the closely related fields of energy, environment and safety, targeted at both nuclear and non-nuclear markets. We also have a major role in providing innovative technology solutions to assist manufacturing industry. The 1990 report on safety within the Authority is presented here. (author).

4769 (INIS-mf–13375, pp. 13) **Training and teaching with Siloette reactor and associated simulators at the Grenoble Nuclear Research Centre.** Destot, M. (CEA Centre d'Etudes Nucleaires de Grenoble (France)). Tajoura Nuclear Research Centre, Tripoli (Libyan Arab Jamahiriya). 1984. 82p. (CONF-8409421–: Seminar on the use of research reactors in fundamental and applied sciences, Tajoura (Libyan Arab Jamahiriya), 16 Sep 1984). In *Seminar on the use of research reactors in fundamental and applied sciences. Programme and abstracts.* Order Number DE93606515. Source: Also available from Tajoura Nuclear Research Centre, Tajoura/Tripoli, Libya.

Short communication. REACTOR SIMULATORS/training; SILOETTE REACTOR/educational facilities; CEA GRENOBLE; TRAINING

4770 (INIS-mf–13375, pp. 14) **Reconstruction and applications of the research reactors of IAE.** Tao Qing Chen (Institute of Atomic Energy, Chinese Academy of Sciences (China)); Zue Zhaoqun. Tajoura Nuclear Research Centre, Tripoli (Libyan Arab Jamahiriya). 1984. 82p. (CONF-8409421–: Seminar on the use of research reactors in fundamental and applied sciences, Tajoura (Libyan Arab Jamahiriya), 16 Sep 1984). In *Seminar on the use of research reactors in fundamental and applied sciences. Programme and abstracts.* Order Number DE93606515. Source: Also available from Tajoura Nuclear Research Centre, Tajoura/Tripoli, Libya.

Short communication. CHINESE ORGANIZATIONS/research programs

4771 (INIS-mf–13377) **International Atomic Energy Agency: Highlights of activities.** Gillen, A. (ed.). International Atomic Energy Agency, Vienna (Austria). Sep 1992 57p. Order Number DE93608135. Source: OSTI; NTIS (US Sales Only); INIS.

This document provides a brief, well-illustrated summary of the activities of the International Atomic Energy Agency in the months up to September 1992. Especially mentioned are the programmes to enhance the safety of nuclear power, from the study of nuclear reactors to assessing the radiological consequences of reactor accidents, and the areas of non-proliferation and safeguards.

4772 (ORNL/M–2490) **Overview and phase 1 implementation guidance.** Oak Ridge National Lab., TN (United States). Nov 1992. 38p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400 ;AC05-76OR00001. (CMWG–2). Order Number DE93003888. Source: OSTI; NTIS; GPO Dep.

The facilities, activities, processes, and experiments managed by Martin Marietta Energy Systems, Inc., often involve materials and processes that are hazardous, sensitive, or costly. The risk that may be inherent in these operations is made acceptable by ensuring that they satisfy requirements established by law and regulation, good design, and good operating practices. Configuration management (CM) is an management process intended to ensure that these operations conform to these requirements. The configuration management concept was developed primarily in the aerospace and nuclear power industries in response to events caused when equipment was not kept in the configuration its designers intended. Some of the events resulted in significant environmental disasters. Investigators found that the events were often caused by breakdowns of management controls. These breakdowns allowed improper changes that left equipment unable to perform as required or as documents indicated it would. The configuration management concept was developed to systematically address these breakdowns. Energy Systems and the Department of Energy (DOE) have generally recognized the need for effective configuration management. Health and safety can be better protected; environmental permits, laws, regulations, and orders can be more consistently complied with; and investments in equipment and special programs, such as safety analyses or "as-built" documentation, can be preserved. Configuration management is not a new concept at Energy Systems. Several facilities and processes currently have configuration management programs and practices that benefit safety and quality. Existing procedures (e.g., records management) and programs (e.g., Safety Analysis Report Update Program) provide a basis for successful configuration management in many organizations.

4773 (VTT-TIED–1326) **International survey of living PSA and safety indicators.** Holmberg, J. (Technical Research Centre of Finland, Espoo (Finland). Lab. of Electrical and Automation Engineering); Laakso, K.; Lehtinen, E.; Johansson, G.; Bjoere, S. Technical Research Centre of Finland, Espoo (Finland). Jan 1992. 74p. Order Number DE93608136. Source: OSTI; NTIS; INIS.

The report contains an international overview of applications of living probabilistic assessment and development of operational safety indicators. Features of an ideal living PSA tool are summarized as well as a limited survey of code systems for managing a living probabilistic safety assessment (living PSA) is included. The international survey is used as an input for planning and performance of related tasks within the nordic NKS/SIK-1 project conducted in 1990-93. The research notes are distributed to the Nordic organizations involved or interested in the subject. The report includes an overview and conclusions from technical reports and articles available and presentations and discussions related to development and use of above methods for the evaluation and management of the operational safety of nuclear power plants. A large part of this material is based on material collected and discussed in connection to international specialist meetings relating to the subject.

4774 (ZfK–731) **1989 annual report of the Rossendorf Central Institute of Nuclear Research. Nuclear and Solid-State Physics Section and Accelerator Department of the Large Equipment Section.** Fromm, W.; Kaun, K.H.; Moeller, K.; Naehring, F.; Schulz, H.; Winter, G.; Heidel, I.; Breiter, S. (comps.). Zentralinstitut fuer Kernforschung, Rossendorf (Germany). 1990. 187p. (In German). Order Number DE93728686. Source: OSTI; NTIS (US Sales Only); INIS.

The research and development results are classified by research lines. Each section starts with an introduction summing up the developments of the particular field of work, followed by progress reports on specific projects, contributions on partial results not published so far, and summaries of 1989 publications. Research priorities are, among others, the fields of nuclear spectroscopy; ion-beam solid state physics; positron emission tomography; nuclear trace technology; neutron doping, and accelerator development. (DG).

9902 Mathematics and Computers

Refer also to citation(s) 2628, 2640, 2641, 2689, 2716, 2734, 2757, 2777, 2781, 2947, 2955, 2966, 2979, 2980, 2981, 2982, 2992, 2995, 2996, 2997, 3019, 3040, 3043, 3049, 3051, 3059, 3067, 3068, 3069, 3070, 3080, 3082, 3083, 3092, 3118, 3119,

3191, 3302, 3438, 3446, 3447, 3451, 3542, 3561, 3562, 3595, 3665, 3771, 3906, 3907, 3919, 3926, 3929, 3942, 3945, 3952, 3977, 4019, 4059, 4060, 4063, 4077, 4105, 4116, 4117, 4128, 4129, 4143, 4183, 4202, 4203, 4235, 4256, 4286, 4448, 4450, 4605, 4673, 4832

4775 (CNEN-DR-GAN-NT–02/86) **FRAPLOT - an auxiliary program of FRAPCON series codes.** Chia, C.T.; Silva, C.F. da. Comissao Nacional de Energia Nuclear (CNEN), Rio de Janeiro, RJ (Brazil). Dept. de Reatores. Nov 1986. 42p. (In Portuguese). Order Number DE93608121. Source: OSTI; NTIS (US Sales Only); INIS.

FRAPLOT computer code which was developed with the aim of formatting the file 17 data of FRAPCON program on an easy way of handle is described. (A.C.A.S.).

4776 (CTA-IEAV-RI–04/87) **NJOY and libraries: complementary information collecting.** Caldeira, A.D.; Chalhoub, E.S.; Ono, S. Centro Tecnico Aeroespacial (CTA-IEAv), Sao Jose dos Campos, SP (Brazil). Inst. de Estudos Avancados. Jun 1987. 19p. (In Portuguese). Order Number DE93608123. Source: OSTI; NTIS (US Sales Only); INIS.

This report contains a list of incompatibilities between NJOY code and evaluate nuclear data libraries, necessary information not included in the user's manual, and errors found in the program. (author).

4777 (CTA-IEAV-RI–08/87) **LIST: a computer code for obtaining reduced copies of files in the CDC CYBER 170/750 computer.** Anaf, J.; Caldeira, A.D. Centro Tecnico Aeroespacial (CTA-IEAv), Sao Jose dos Campos, SP (Brazil). Inst. de Estudos Avancados. Oct 1987. 11p. (In Portuguese). Order Number DE93608124. Source: OSTI; NTIS (US Sales Only); INIS.

A program for obtaining legible copies of computer files, in accordance with present IEAv publication norms, is presented. (author).

4778 (CTA-IEAV-RI–010/87) **Implementation of LINEAR (87-1), RECENT (87-1), SIGMA 1 (86-1) and GROUPIE (86-1) computer programs.** Anaf, J.; Chalhoub, E.S. Centro Tecnico Aeroespacial (CTA-IEAv), Sao Jose dos Campos, SP (Brazil). Inst. de Estudos Avancados. Nov 1987. 19p. (In Portuguese). Order Number DE93608122. Source: OSTI; NTIS (US Sales Only); INIS.

Problems encountered in implementing the new versions of the computer programs LINEAR, RECENT, SIGMA 1 AND GROUPIE, in the CDC CYBER 170/750 at IEAv, are presented. (author).

4779 (DOE/ER/12810–1) **Variational nodal transport methods for hexagonal and three-dimensional geometries: Final report.** Lewis, E.E. Northwestern Univ., Evanston, IL (United States). Dept. of Mechanical Engineering. Feb 1992. 5p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG02-88ER12810. Order Number DE93002131. Source: OSTI; NTIS; INIS; GPO Dep.

The properties of the variational nodal method for neutron transport calculations are investigated. The method is generalized for three-dimensional multigroup criticality problems in both hexagonal-z and Cartesian geometries. The method is implemented as part of the Argonne National Laboratory Code DIF3D, and applied to a series of benchmark reactor calculations. Variational nodal methods are compared of nodal transport methods based on both interface-current and discrete ordinate approximations. Model problems are used to examine the effect of running each of the three classes of nodal transport methods on computers with massively parallel architectures.

4780 (DOE/ER/13846–4) **[Mathematical models of hysteresis]: Progress report No. 4, [January 1, 1991–December 31, 1991].** Mayergoyz, I.D. Maryland Univ., College Park, MD (United States). [1991]. 19p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG05-88ER13846. Order Number DE93001836. Source: OSTI; NTIS; GPO Dep.

The research described in this proposal is currently being supported by the US Department of Energy under the contract "Mathematical Models of Hysteresis". Thus, before discussing the proposed research in detail, it is worthwhile to describe and summarize the main results achieved in the course of our work under the above contract. Our ongoing research has largely been focused on the development of mathematical models of hysteretic nonlinearities with "nonlocal memories". The distinct feature of these nonlinearities is that their current states depend on past histories of input variations. It turns out that memories of hysteretic nonlinearities are quite selective. Indeed, experiments show that only some past input extrema leave their marks upon future states of hysteretic nonlinearities. Thus special mathematical tools are needed in order to describe nonlocal selective memories of hysteretic nonlinearities. Our research has been primarily concerned with Preisach-type models of hysteresis. All these models have a common generic feature; they are constructed as superpositions of simplest hysteretic nonlinearities-rectangular loops. Our study has by and large been centered around the following topics: various generalizations and extensions of the classical Preisach model, finding of necessary and sufficient conditions for the representation of actual hysteretic nonlinearities by various Preisach type models, solution of identification problems for these models, numerical implementation and experimental testing of Preisach type models. Although the study of Preisach type models has constituted the main direction of the research, some effort has also been made to establish some interesting connections between these models and such topics as: the critical state model for superconducting hysteresis, the classical Stoner-Wohlfarth model of vector magnetic hysteresis, thermal activation type models for viscosity, magnetostrictive hysteresis and neural networks.

4781 (DOE/ER/25052–T1) **Ultracomputer Research Project: Progress report, January 1, 1992–December 31, 1992.** Gottlieb, A. New York Univ., NY (United States). Courant Inst. of Mathematical Sciences. Oct 1992. 17p. Sponsored by USDOE, Washington, DC (United States); National Science Foundation, Washington, DC (United States). DOE Contract FG02-88ER25052. Order Number DE93002096. Source: OSTI; NTIS; GPO Dep.

This document presents significant accomplishments made on the Ultracomputer Research Project during CY92.

4782 (DOE/ER/25107–1) **[SIAM conference on optimization].** Society for Industrial and Applied Mathematics (SIAM), Philadelphia, PA (United States). Inst. for Mathematics and Society. 10 May 1992. 69p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG02-91ER25107. (CONF-9205257–Absts.: 4. Society for Industrial and Applied Mathematics (SIAM) conference on optimization, Chicago, IL (United States), 11-13 May 1992). Order Number DE93000781. Source: OSTI; NTIS; GPO Dep.

Abstracts are presented of 63 papers on the following topics: large-scale optimization, interior-point methods, algorithms for optimization, problems in control, network optimization methods, and parallel algorithms for optimization problems.

4783 (DOE/MC/24207–3007) **ISPE: A knowledge-based system for fluidization studies: 1990 Annual report.** Reddy, S. West Virginia Univ., Morgantown, WV (United States). Dept. of Statistics and Computer Science. Jan 1991. 80p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FC21-87MC24207. Order Number DE91002087. Source: OSTI; NTIS; GPO Dep.

Chemical engineers use mathematical simulators to design, model, optimize and refine various engineering plants/processes. This procedure requires the following steps: (1) preparation of an input data file according to the format required by the target simulator; (2) excecuting the simulation; and (3) analyzing the results of the simulation to determine if all "specified goals" are satisfied. If the goals are not met, the input data file must be modified and the simulation repeated. This multistep process is continued until satisfactory results are obtained. This research was undertaken to develop a knowledge based system, IPSE (Intelligent Process Simulation Environment), that can enhance the productivity of chemical engineers/modelers by serving as an intelligent assistant to perform a variety tasks related to process simulation. ASPEN, a widely used simulator by the US Department of Energy (DOE) at Morgantown Energy Technology Center (METC) was selected as the target process simulator in the project. IPSE, written in the C language, was developed using a number of knowledge-based programming paradigms: object-oriented knowledge representation that uses inheritance and methods, rulebased inferencing (includes processing

and propagation of probabilistic information) and data-driven programming using demons. It was implemented using the knowledge based environment LASER. The relationship of IPSE with the user, ASPEN, LASER and the C language is shown in Figure 1.

4784 (EGG-CODP–10030(9-92)) **EXCHANGE: Volume 9-92.** Boltz, J.C. (ed.). EG and G Idaho, Inc., Idaho Falls, ID (United States). INEL Supercomputing Center. Sep 1992. 18p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC07-76ID01570. Order Number DE93001961. Source: OSTI; NTIS; GPO Dep.

EXCHANGE is published monthly by the Idaho National Engineering Laboratory (INEL), a multidisciplinary facility operated for the US Department of Energy (DOE). The purpose of EXCHANGE is to inform computer users about about recent changes and innovations in both the mainframe and personal computer environments and how these changes can affect work being performed at DOE facilities.

4785 (ESTSC–000140IBMPC01) **MEPAS2.3G: Multimedia Environmental Pollutant Assessment System.** Dropo, J.G. Jr. (Pacific Northwest Lab., Richland, WA (United States)); Whelan, G.; Strenge, D.L.; Buck, J.W.; Hoopes, B.L. Battelle-Northwest, Richland, WA (United States). Pacific Northwest Lab. 10 Dec 1992. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Source: ESTSC.

Description: IBM PC; Microsoft DOS (3.n or 5.n); MICROSOFT FORTRAN (75%) DBASE III+ (20%) Microsoft C (5%); 3 3.5 Diskettes. Large applications with many problems should be subdivided into different application directories. Ten to twenty problems per application directory will give good performance. Too many problems will result in delay for data file updates.

Integrated system to compute long-term public health risks as the result of the release of hazardous and/or radioactive materials to air, groundwater, surface water, and overland transport pathways.

4786 (ESTSC–000197IBMPC02) **PCES 2.0: Performance Criteria and Evaluation System.** Jackson, L.L. (Halliburton NUS Environmental Corp., Aiken, SC (United States)). NUS Corp., Aiken, SC (United States). 7 Dec 1992. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC09-92SR18220. Source: ESTSC.

Description: IBM PC; MS DOS 3.3 or compatible; Clipper Summer '87 (100%); 7 3.5 Diskettes. Due to the size of the data base (6+ MB), PKZIP.EXE and ZIP2EXE.EXE were used to compress the data base. A C routine was written to further split the large file into smaller binary files that will fit on a disk. The DOS copy + /B is used to rejoin the binary files onto the hard drive. This method was chosen to eliminate the limitations of the DOS backup and restore commands. PKZIP and ZIP2EXE were also used for the executable and associated files to minimize the number of diskettes required for distributions of the program.

The Performance Criteria and Evaluation System (PCES) was developed in order to make a data base of criteria accessible to radiation safety staff. The criteria included in the package are applicable to occupational radiation safety at DOE reactor and nonreactor nuclear facilities, but any data base of criteria may be created using the Criterion Data Base Utility (CDU). PCES assists personnel in carrying out oversight, line, and support activities.

4787 (ESTSC–000349IBMPC01) **BETA: Brookhaven Event Tree Analyzer.** Shier, W. (Brookhaven National Lab., Upton, NY (United States)). Brookhaven National Lab., Upton, NY (United States). 1 Jan 1990. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC02-76CH00016. Source: ESTSC.

Description: IBM PC; DOS; ASCII; 1 3.5 Diskette. The source code is not supplied with BETA.

BETA is the Brookhaven Event Tree Analyzer. BETA is used in Probalistic Risk Assessment (PRA). Event trees are key elements in applying PRA in pre-coceptual design for safety enhancement of Oak Ridge National Laboratory's Advanced Neutron Source (ANS) research reactor which will be the world's best source of low-energy neutrons for material studies, physics research, transplutonium production and radiation research.

4788 (ESTSC–000429IPCAT00) **MEOR4D: Measurement of interfacial tension by use of pendant drop video techniques.** Herd, M.D. (EG and G Idaho, Inc., Idaho Falls, ID (United States)); Thomas, C.P.; Bala, G.A.; Lassahn, G.D. EG and G Idaho, Inc., Idaho Falls, ID (United States). 1 Jun 1992. Sponsored by USDOE, Washington, DC (United States). Source: ESTSC.

Description: IBM PC/AT; DOS; C; 1 3.5 diskette.

An instrument and associated software to measure the interfacial tension (IFT) of aqueous surfactant solutions and crude oil. The method involves injection of a drop of fluid (such as crude oil) into a second immiscible phase to determine the IFT between the two phases. The instrument is composed of an AT-class computer, optical cell, illumination, video camera and lens, video frame digitizer board, monitor, and software. The camera displays an image of the pendant drop on the monitor, which is then processed by the frame digitizer board and non-proprietary software to determine the IFT. Several binary and ternary phase systems were taken from the literature and used to measure the precision and accuracy of the instrument in determining IFTs.

4789 (ESTSC–000536IBMPC00) **LIMENU: Menu driven program determining properties of aqueous lithium bromide solutions.** Patterson, M.R. (Oak Ridge National Lab., TN (United States)); Crosswhite, R.N.; Perez-Blanco, H. Oak Ridge National Lab., TN (United States). 1 Jan 1990. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. Source: ESTSC.

Description: IBM PC; DOS; FORTRAN; 1 5.25 Diskette.

LIMENU is a menu driven program written to compute seven physical properties of a lithium bromide-water solution and three physical properties of water, and to display two plots.

4790 (ESTSC–000538I036000) **PRODCOST: Utility generating cost simulation.** Hudson, C.R.II (Oak Ridge National Lab., TN (United States)); Reynolds, T.M.; Smolen, G.R. Oak Ridge National Lab., TN (United States). 1 Feb 1981. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-26. (NESC–960). Source: ESTSC.

Description: IBM360; OS/370; FORTRAN IV (97%) and Assembler (3%); 1 Mag Tape.

PRODCOST simulates the operation of an electric utility generation system. Through a probabilistic simulation the expected energy production, fuel consumption, and cost of operation for each unit in the system are determined. Total system fuel consumption, energy generation by type, total generation costs, as well as system loss of load probability and expected unserved energy are calculated. The code does not take into account the transmission and distribution system of the utility. It assumes that there are no transmission limitations within the system. Finite energy exchanges with neighboring utilities can be modeled.

4791 (ESTSC–000539I036000) **VENTURE: 1, 2, or 3-d multigroup diffusion.** Vondy, D.R. (Oak Ridge National Lab., TN (United States)); Fowler, T.B.; Cunningham, G.W. Oak Ridge National Lab., TN (United States). 1 Apr 1979. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. (NESC–686). Source: RADIATION SHIELDING INFORMATION CENTER.

Description: IBM360; OS/360; FORTRAN IV and Assembly language; 1 Mag Tape. Programming is in the Standard ANSI FORTRAN 1966 language except for extensions as required for unindexed block data transfers and direct access. Arrays are limited to 3 dimensions, subroutines to 60 arguments, and no use is made of subscripted subscripts. Standard routines developed in the ERDA Reactor Physics code coordination effort are employed for processing input data and data file management. Local system environment routines for computing elapsed time, allocating memory, and setting up direct access file specifications dynamically will require replacement.

VENTURE solves the usual neutronics eigenvalue, adjoint, fixed source, and criticality search (direct and indirect) problems, treating up to three geometric dimensions, maps power density and does first-order perturbation analysis at the macroscopic cross section level.

4792 (ESTSC–000540CY00100) **TART: Coupled neutron & photon MC transport.** Plechaty, E.F. (Lawrence Livermore National Lab., CA (United States)). Lawrence Livermore National Lab., CA (United States). 4 Jul 1976. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. (NESC–9574). Source: RADIATION SHIELDING INFORMATION CENTER.

Description: CRAY1; CTSS; LRLTRAN; 1 Mag Tape.

TART is a three-dimensional, data-dependent Monte Carlo transport program. The program calculates the transport of neutrons, photons, and neutron-induced photons through zones described by algebraic functions. The zones and elements to be included are user-specified. Any one of 21 different output tallys (methods of calculating particle transport) may be selected for each zone. A spectral reflection tally, which calculates reflections from planes and quadratic surfaces, saves considerable time and effort for some classes of problems. The neutron and photon energy deposition output tally is included in all TART calculations. The neutron and gamma-ray production cross sections are specified from 10E-9 MeV to 20 MeV. The gamma-ray interaction cross sections are specified from 10E-4 MeV to 30 MeV. The three cross section libraries are provided in binary form. Variance reduction methods included are splitting and Russian roulette at zone boundaries. Each zone in the problem can be assigned a weight.

4793 (ESTSC–000541C660000) **TOR: Thermal scattering crystalline materials.** Clendenin, W.W. (Los Alamos National Lab., NM (United States)); Labauve, R. Los Alamos National Lab., NM (United States). 1 Oct 1969. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. (NESC–360). Source: RADIATION SHIELDING INFORMATION CENTER.

Description: CDC6600; SCOPE; FORTRAN IV; 1 Mag Tape. Logical tape 10 is input, logical tape 9 is output, logical tape 11 is punch.

The TOR program calculates the scattering law for a crystalline material in the incoherent approximation, from the phonon frequency distribution and a specified temperature. A proportional quantity is punched in the form of a table for interpolation of the double differential cross section. As an alternative, the program obtains the analogous quantities for a monatomic gas.

4794 (ESTSC–000542H600000) **TRIAL: 3-d reaction rates from 2-d flux sets.** Cowan, C.L. (General Electric Co., Sunnyvale, CA (United States)). General Electric Co., Sunnyvale, CA (United States). Advanced Technology Dept. 1 Mar 1973. Sponsored by USDOE, Washington, DC (United States). (NESC–585). Source: RADIATION SHIELDING INFORMATION CENTER.

Description: HONEYWELL 6000; GCOS6000; FORTRAN IV; 1 Mag Tape. All input flux sets and the output 3-D flux set are prescribed in the format of the standard interface file, as recommended by the Standard Interface File Subcommittee of the Computer Code Coordination Committee (see reference 2).

TRIAL carries out a simple linking of several two-dimensional, multigroup neutron (direct or adjoint) flux sets to give a three-dimensional representation.

4795 (ESTSC–000543I036000) **U3R: Unresol resonance xsec probability tables.** Otter, J.M. (Rockwell International, Canoga Park, CA (United States)); Lewis, R.C.; Levitt, L.B. Rockwell International Corp., Canoga Park, CA (United States). Rocketdyne Div. 31 Jul 1972. Sponsored by USDOE, Washington, DC (United States). (NESC–553). Source: RADIATION SHIELDING INFORMATION CENTER.

Description: IBM360; OS/360; FORTRAN IV, Assembly language random number generator; 1 Mag Tape.

U3R numerically constructs a table of the cumulative probability distribution functions of unresolved resonance cross sections in a narrow energy range.

4796 (ESTSC–000544C760000) **LPMGB: Linear programming subroutine w/bounds.** Hanson, R.J. (Sandia National Labs., Albuquerque, NM (United States)); Wisniewski, J.A. Sandia National Labs., Albuquerque, NM (United States). 1 Aug 1979. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-76DP00789. (NESC–913). Source: ESTSC.

Description: CDC7600; SCOPE 2.1 (CDC7600); NOS 1.3 (CD-FORTRAN; 1 Mag Tape. The FLECS structured-FORTRAN preprocessor was used to produce the LPMGB source, which is written to be readily transportable to a variety of computers. To implement LPMGB on other than CDC or IBM machines, the environmental parameters in function I1MACH should be modified as described in the introductory comments of that routine.

LPMGB minimizes a linear function of several variables subject to linear equality constraints with bounds on selected variables.

4797 (ESTSC–000544I037000) **LPMGB: Linear programming subroutine w/bounds.** Hanson, R.J. (Sandia National Labs., Albuquerque, NM (United States)); Wisniewski, J.A. Sandia National Labs., Albuquerque, NM (United States). 1 Aug 1979. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-76DP00789. (NESC–913). Source: ESTSC.

Description: IBM370; OS/370; FORTRAN; 1 Mag Tape. The FLECS structured-FORTRAN preprocessor was used to produce the LPMGB source, which is written to be readily transportable to a variety of computers. To implement LPMGB on other than CDC or IBM machines, the environmental parameters in function I1MACH should be modified as described in the introductory comments of that routine.

LPMGB minimizes a linear function of several variables subject to linear equality constraints with bounds on selected variables.

4798 (FNAL/C–92/163) **CPS and the Fermilab farms.** Fausey, M.R. Fermi National Accelerator Lab., Batavia, IL (United States). Jun 1992. 25p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC02-76CH03000. (CONF-930117–3: 26. Hawaiian international conference on system science: biotechnology computing track, Kauai, HI (United States), 5-8 Jan 1993). Order Number DE92018311. Source: OSTI; NTIS; INIS; GPO Dep.

Cooperative Processes Software (CPS) is a parallel programming toolkit developed at the Fermi National Accelerator Laboratory. It is the most recent product in an evolution of systems aimed at finding a cost-effective solution to the enormous computing requirements in experimental high energy physics. Parallel programs written with CPS are large-grained, which means that the parallelism occurs at the subroutine level, rather than at the traditional single line of code level. This fits the requirements of high energy physics applications, such as event reconstruction, or detector simulations, quite well. It also satisfies the requirements of applications in many other fields. One example is in the pharmaceutical industry. In the field of computational chemistry, the process of drug design may be accelerated with this approach. CPS programs run as a collection of processes distributed over many computers. CPS currently supports a mixture of heterogeneous UNIX-based workstations which communicate over networks with TCP/IR CPS is most suited for jobs with relatively low I/O requirements compared to CPU. The CPS toolkit supports message passing remote subroutine calls, process synchronization, bulk data transfers, and a mechanism called process queues, by which one process can find another which has reached a particular state. The CPS software supports both batch processing and computer center operations. The system is currently running in production mode on two farms of processors at Fermilab. One farm consists of approximately 90 IBM RS/6000 model 320 workstations, and the other has 85 Silicon Graphics 4D/35 workstations. This paper first briefly describes the history of parallel processing at Fermilab which lead to the development of CPS. Then the CPS software and the CPS Batch queueing system are described. Finally, the experiences of using CPS in production on the Fermilab processor farms are described.

4799 (IAEA-TECDOC–660) **Expert systems in the nuclear industry: Report of a technical committee meeting/workshop held in Springfields, United Kingdom, 30 September - 4 October 1991.** International Atomic Energy Agency, Vienna (Austria). Jul 1992. 219p. (CONF-9109435–: Technical committee meeting/workshop on demonstration and review of expert system prototypes, Springfields (United Kingdom), 30 Sep - 4 oct 1991). Order Number DE93606682. Source: OSTI; NTIS (US Sales Only); INIS.

Recent developments in expert system technology have led to the question whether such systems could be used for the enhancement of nuclear safety, particularly as advisory system during abnormal plant conditions. This document was produced during the Technical Committee Meeting (TCM) to Demonstrate and Review Expert System Prototypes, which was organized jointly by the International Atomic Energy Agency and British Nuclear Fuels Ltd (BNFL) and held at the BNFL site in Springfields, United Kingdom, from 30 September to 4 October 1991. A separate abstract was prepared for each of the 14 papers in this document. Refs, figs and tabs.

4800 (IAEA-TECDOC–660, pp. 71-88) **Real-time knowledge-based supervision and fault diagnosis for industrial applications using COGSYS.** Davison, S.J. (COGSYS Ltd, Salford (United Kingdom)); Burras, S.R.J. International Atomic Energy Agency, Vienna (Austria). Jul 1992. (CONF-9109435–: Technical committee meeting/workshop on demonstration and review of expert system prototypes, Springfields (United Kingdom), 30 Sep 1991). In *Expert systems in the nuclear industry: Report of a technical committee meeting/workshop held in Springfields, United Kingdom, 30 September - 4 October 1991.* 219p. Order Number DE93606682. Source: OSTI; NTIS (US Sales Only); INIS.

This paper describes the development and application of a new real-time expert system called COGSYS. COGSYS was developed through a collaborative project involving 35 major European companies. The project began life in 1987 following on from the successful completion of an earlier real-time expert system project called RESCU (Real-time Expert System Club of Users), which was a similar collaborative project funded under the Government's Alvey initiative. As an awareness project RESCU allowed the club members to gain sufficient insight into the potential benefits through its application to a detergent manufacturing plant at ICI Wilton to justify a further project aimed at the commercialisation of the system. The COGSYS project lasted 3 years and culminated with demonstration at 2 test-sites, British Gas in Solihull and CMB Technology in Wantage. The British Gas application involved a decision support system for a gas production plant and the CMB application is based on quality control of a laminated plastic bottle making process. COGSYS is now being marketed by a company of the same name, set up by the British Gas, SD-Scicon and Salford University Business Enterprises. (author). 8 refs.

4801 (IAEA-TECDOC–660, pp. 89-102) **Design issues of real-time knowledge based systems.** Sassen, J.M.A. (Delft Univ. of Technology, Delft (Netherlands). Inst. of Applied Computer Science); Jaspers, R.B.M. International Atomic Energy Agency, Vienna (Austria). Jul 1992. (CONF-9109435–: Technical committee meeting/workshop on demonstration and review of expert system prototypes, Springfields (United Kingdom), 30 Sep 1991). In *Expert systems in the nuclear industry: Report of a technical committee meeting/workshop held in Springfields, United Kingdom, 30 September - 4 October 1991.* 219p. Order Number DE93606682. Source: OSTI; NTIS (US Sales Only); INIS.

PERFECT (Programming EnviRonment For Expertsystems Constrained in reasoning Time) aims at supporting knowledge engineers during the development of real-time knowledge based systems (RTKBS). It provides support at the knowledge level (Newell 1981) in offering guidance in modeling complex industrial processes, and in supplying ways to use this knowledge model during problem solving. A generic modeling technique for RTKBS is described. A part from support in modelling, PERFECT also provides support at the level of (real-time) software engineering by means of an analyzer that predicts the response-time of the knowledge model at run-time when using the model for diagnosis of disturbance. In case the response-time is not as required, the analyzer proposes an alternative structure for the knowledge model and checks whether the resulting knowledge model is observable. (author). 18 refs, 10 figs.

4802 (IAEA-TECDOC–660, pp. 65-69) **British nuclear fuels off-line expert systems.** Unsworth, D. (British Nuclear Fuels plc, Risley (United Kingdom). Corporate Management Services). International Atomic Energy Agency, Vienna (Austria). Jul 1992. (CONF-9109435–: Technical committee meeting/workshop on demonstration and review of expert system prototypes, Springfields (United Kingdom), 30 Sep - 4 oct 1991). In *Expert systems in the nuclear industry: Report of a technical committee meeting/workshop held in Springfields, United Kingdom, 30 September - 4 October 1991.* 219p. Order Number DE93606682. Source: OSTI; NTIS (US Sales Only); INIS.

This paper describes the work of the British Nuclear Fuels plc (BNFL) Expert Systems Team. It covers the background to Expert Systems within BNFL, the method for developing off-line Expert Systems, applications within BNFL and future developments affecting off-line Expert Systems. (author).

4803 (IAEA-TECDOC–660, pp. 103-109) **AI-techniques in plant operation and in the design of plant automatics.** Vaelisuo, H. (Technical Research Centre of Finland, Espoo (Finland). Lab. of Electrical and Automation Engineering). International Atomic Energy Agency, Vienna (Austria). Jul 1992. (CONF-9109435–: Technical committee meeting/workshop on demonstration and review of expert system prototypes, Springfields (United Kingdom), 30 Sep 1991). In *Expert systems in the nuclear industry: Report of a technical committee meeting/workshop held in Springfields, United Kingdom, 30 September - 4 October 1991.* 219p. Order Number DE93606682. Source: OSTI; NTIS (US Sales Only); INIS.

The role of AI-techniques in the implementation of computerised operator support systems is discussed. It is suggested that similar problems are encountered in control system design. Solving various plant control problems is considered as the dominant task. Different techniques to solve control problems and the knowledge they require are reviewed. It is pointed out that knowledge base need not be a set of rules on how to solve the problems is a given domain. The knowledge base may also be a (qualitative) description of the problem domain (e.g. a power plant). Finally a research project addressing the problem of computerized operator support systems is sketched. (author). 3 refs, 3 figs.

4804 (IEN-DERE-DIMEC–06/85) **Computer program verification project C.E.E. - Benchmark problems - step 1.** Jospin, R.J.; Correia Filho, A.; Goncalves Filho, O.J.A. Instituto de Engenharia Nuclear (IEN), Rio de Janeiro, RJ (Brazil). Div. de Mecanica Estrutural. Aug 1985. 66p. Order Number DE93608125. Source: OSTI; NTIS (US Sales Only); INIS.

This report presents the numerical solutions obtained, through the finite element method, for three benchmark problems involving different types of material nonlinear behaviour of a clamped circular plate subject to an uniform distributed load. This work represents the initial participation of the Division of Structural Mechanics/IEN in the Computer Program Verification Project developed by the European Economic Communities. (author).

4805 (IRD-CNEN-NT–010/87) **A multi-channel microcomputer data acquisition system.** Loureiro, J.S. Instituto de Radioprotecao e Dosimetria (IRD), Rio de Janeiro, RJ (Brazil). 1987. 16p. (In Portuguese). Order Number DE93608126. Source: OSTI; NTIS (US Sales Only); INIS.

A data acquisition system was developed in order to transfer automatically to a 64 kb microcomputer the data generated by a nuclear spectroscopy system in a multichannel analyser. The data in the memory are stored in a floppy disk and will be further used as data entry for any spectrum analysis program, eliminating the tedious work of manually digitizing the spectrum and the possible mistakes associated with it. The developed system connected a POLYMAX 201 DP microcomputer, under CP/M operational system, to a NUCLEAR DATA MODEL ND-65 multichannel analyser and was planned for either local spectrum analysis in the microcomputer using a simplified program, or remote analysis in a mainframe using the sophisticated analysis program SAMPO. With the present system, the time spent between printing out of the 4096 channels with the multichannel analyser printer and its corresponding introduction in the analysis program has been reduced from about 6 hours to less than 2 minutes. (author).

4806 (KFK–5001) **Visualization in complex systems and its application in environmental protection.** Denzer, R. Kernforschungszentrum Karlsruhe GmbH (Germany). Inst. fuer Datenverarbeitung in der Technik; Kernforschungszentrum Karlsruhe GmbH (Germany). Projekt Schadstoff- und Abfallarme

Verfahren (PSA); Kaiserslautern Univ. (Germany). Fachbereich Informatik. Apr 1992. 148p. (In German). Order Number DE93728985. Source: OSTI; NTIS (US Sales Only).

Especially for environmental information systems there is a new quality in the design of end user dialogues. The data needed at a workplace may be distributed over a large network, where it is not always obvious where the data may be found. The computer network itself is a complex system which operates on the data of the complex system "environment". The visualization of the complex system "environment" therefore is some kind of visualization within a complex system. A new architecture for graphical user interfaces is presented. The architecture shows a conceptual framework for the design of flexible end user interfaces for complex systems. The architecture is based on a new communication concept for open distributed systems which is capable to integrate remote data very easily into the user interface. The communication concept is a general one and therefore not limited to user interface implementation. The second main concept is the integration of representation and application components in opposition to the Seeheim model. This is called integrated modeling. The implementation of the user interface is done using a combination of object orientation and rule based methods. (orig./BBR).

4807 (LA–11990-C) **Workshop on online documentation in the supercomputing environment.** Caldwell, G. (National Center for Atmospheric Research, Boulder, CO (United States)); Rew, J. (comps.); Cohen, M.; Solem, A. (comps.). Los Alamos National Lab., NM (United States); National Center for Atmospheric Research, Boulder, CO (United States). Dec 1990. 171p. Sponsored by USDOE, Washington, DC (United States); National Science Foundation, Washington, DC (United States). DOE Contract W-7405-ENG-36. (NCAR/TN–353;CONF-9004367–Summs.: Workshop on online documentation in the supercomputing environment, Colorado Springs, CO (United States), 3-6 Apr 1990). Order Number DE92040949. Source: OSTI; NTIS; GPO Dep.

Many people are interested in online user documentation for supercomputers and the continuing problems that plague us: problems of delivering online information in a heterogeneous computing environment that includes supercomputers and workstations, and lack of vendor solutions that work in diverse computing environments for diverse types of documentation. These problems have made it difficult to develop online documentation systems that have proved to be broadly effective. With changing technology and supercomputing environments, we believe the time is right to make substantial progress in this field. It was in this context that the National Center for Atmospheric Research and Los Alamos National Laboratory organized the Workshop on Online Documentation in the Supercomputing Environment in Colorado Springs, April 3–6, 1990. Twenty-eight participants came from leading supercomputing sites, including the national laboratories, National Institute of Standards and Technology, the National Science Foundation supercomputing centers, university and regional supercomputing centers and Cray Research and IBM. As a group representing twelve diverse supercomputing centers, participants in the workshop saw a need for a common online documentation system that could serve a heterogeneous distributed computing environment. We also desired the efficiency to be gained of sharing documentation in machine-readable form among hardware and software vendors as well as between supercomputing centers. We did not see any currently existing software products meeting all of these needs. We thus believed we needed to establish a forum to advocate the development or evolution of a suitable online documentation system. We hope that this workshop has resulted in increased understanding and will have served as another step toward the development of online documentation for supercomputer users.

4808 (LA-UR–92-2511) **An algebraic foundation for FORTRAN 90 communication intrinsics.** Stiller, L. (Los Alamos National Lab., NM (United States)). Los Alamos National Lab., NM (United States). [1992]. 11p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. (CONF-930129–1: Working conference on architecture and compilation techniques for fine and medium grain parallelism, Orlando, FL (United States), 20-22 Jan 1993). Order Number DE92040393. Source: OSTI; NTIS; GPO Dep.

This paper proposes linear algebra and multilinear algebra as a foundation for the implementation and the understanding of several fundamental parallel communication operations. We will analyze three representative operations: the FORTRAN 90 intrinsic SPREAD, the FORTRAN 90 intrinsic SUM and the parallel prefix operator SCAN. By formulating the operations as linear transformations, we hope to be able to apply linear algebraic techniques to reorder and to factor both these transformations and higher level user functions that call these primitives. Several applications of this technique will be discussed. Perhaps the most surprising was simple code that sped up the SPREAD intrinsic on the CM-200 by a factor of up to 6 and the SUM intrinsic by a factor of up to 20. This speedup had immediate and dramatic impact on many parallel programs. The SUM intrinsic was also sped up on the CM-5.

4809 (LA-UR–92-2972) **Statistical error in a chord estimator of correlation dimension: The "rule of five".** Theiler, J. (Los Alamos National Lab., NM (United States)); Lookman, T. Los Alamos National Lab., NM (United States). 1 Sep 1992. 14p. Sponsored by USDOE, Washington, DC (United States); Department of Health and Human Services, Washington, DC (United States). DOE Contract W-7405-ENG-36. Grant 1-R01-MH47184-01. (CONF-9208161–1: 2. bifurcations and chaos workshop on dynamical measures of complexity and chaos, Bryn Mawr, PA (United States), 13-15 Aug 1992). Order Number DE93000687. Source: OSTI; NTIS; INIS; GPO Dep.

The statistical precision of a chord method for estimating dimension from a correlation integral is derived. The optimal chord length is determined, and a comparison is made to other estimators. The simple chord estimator is only 25% less precise than the optimal estimator which uses the full resolution and full range of the correlation integral. The analytic calculations are based on the hypothesis that all pairwise distances between the points in the embedding space are statistically independent. The adequacy of this approximation is assessed numerically, and a surprising result is observed in which dimension estimators can be anomalously precise for sets with reasonably uniform (nonfractal) distributions.

4810 (LA-UR–92-3200) **From the rotation group to the Poincare group.** Louck, J.D. Los Alamos National Lab., NM (United States). [1992]. 15p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. (CONF-9208164–1: 6. symmetries in science, Bregenz (Austria), 2-7 Aug 1992). Order Number DE93000864. Source: OSTI; NTIS; GPO Dep.

Larry Biedenham is, perhaps, best known for his penetrating insights into the relevance of abstract mathematics for the structure of physical theory and his ability to implement this mathematics in a style comprehensible to physicists. This is well-illustrated by his many recent contributions to q-algebras. He has also written numerous papers concerned with the pedagogy of physical theory – papers with the purpose of clarifying the content and meaning of a subject. It is in the spirit of these latter contributions that the present paper is presented. The subject is the quantum rotation group, SU(2), the group of 2×2 unitary unimodular matrices, and its fundamental role in physical theory. The fact that the irreducible representations (irreps) of the group SU(2) can be realized by unitary transformation of state vectors whose domain of definition is the usual Euclidean 3-space, R^3, is usually obscured by the fact that one is accustomed to thinking of the underlying group of transformations on R^3 the group SO(3,R) of proper orthogonal matrices. We show in the first part of this paper how one can formulate the usual "orbital angular momentum theory" from the viewpoint of SU(2) alone. The motivation for this approach is to eliminate from the language of quantum mechanics the ambiguities arising from the highly unsatisfactory notion of "double-valued functions." In the second part of the paper, we show how the irreps of SU(2), extended to GL(2,C), enter into the description of the unitary irreps of the Poincare group. We emphasize again the uniform role of SU(2), in contrast to SO(3,R), and point out the several ways that the standard irreps of SU(2) occur. In the third part of the paper, we discuss the parametrization of SL(2,C) in terms of biquaternions and mention the problem of determining the discrete subgroups of SL(2,C).

4811 (LA-UR–92-3214) **NADIR: A prototype system for detecting network and file system abuse.** Hochberg, J.G.; Jackson, K.A.; Stallings, C.A.; McClary, J.F.; DuBois, D.H.; Ford, J.R. Los Alamos National Lab., NM (United States). [1992]. 22p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. (CONF-9211108–1: 7. European conference on information systems security, audit, and control, Brussels (Belgium), 16-18 Nov 1992). Order Number DE93000861. Source: OSTI; NTIS; GPO Dep.

This paper describes the design of a prototype computer misuse detection system for the Los Alamos Notional Laboratory's Integrated Computing Network (ICN). This automated expert system, the Network Anomaly Detection and Intrusion Reporter (NADIR), streamlines and supplements the manual audit record review traditionally performed by security auditors. NADIR compares network activity, as summarized in weekly profiles of individual users and the ICN as a whole, against expert rules that define security policy, improper or suspicious behavior, and normal user activity. NADIR reports suspicious behavior to security auditors and provides tools to aid in follow-up investigations. This paper describes analysis by NADIR of two types of ICN activity: user authentication and access control, and mass file storage. It highlights system design issues of data handling, exploiting existing auditing systems, and performing audit analysis at the network level.

4812 (LUTFD2-TFRT–5440-1-100-1991) **Are expert systems needed on the power exchange?.** Nilsson, David. Lund Univ. (Sweden). Dept. of Automatic Control. Sep 1991. 100p. (In Swedish). Order Number DE93608127. Source: OSTI; NTIS; INIS.

Examination paper.

The goal of this masters thesis is to investigate whether it is possible to improve the activities at the power production unit (PDP) at Sydkraft with the help of expert systems. Another goal is that the produced result should work as an education material for the production operators. Therefore the work contains a detailed description of the power exchange and the factors that influence it, in addition to a description of the work tasks of the operators. The conclusions are, first, that an embedded critiquing system would enable a quicker training of new operators, while also giving the more experienced operators feedback on their decisions. Secondly, the water storage operation should be documented, to create a basis for the development of an expert system, and to create more material for education. The thesis also suggests a new model for the development of expert systems in areas where it is not known whether such a solution is possible. (au).

4813 (ORNL/TM–12167) **Overdispersion: Notes on discrete distributions.** Bowman, K.O. (Oak Ridge National Lab., TN (United States)); Shenton, L.R.; Kastenbaum, M.A.; Broman, K. Oak Ridge National Lab., TN (United States). Sep 1992. 91p. Sponsored by USDOE, Washington, DC (United States); National Science Foundation, Washington, DC (United States). DOE Contract AC05-84OR21400. Order Number DE93003674. Source: OSTI; NTIS; GPO Dep.

We introduce mixtures of binomial distributions derived by assuming that the probability parameter p varies according to some law. We use the transformation $p = \exp(-t)$ and consider various appropriate densities for the transformed variables. In the process, the Laplace transform becomes the fundamental entity. Large numbers of new binomial mixtures are generated in this way. Some transformations may involve several variates that lead to "multivariate" binomial mixtures. An extension of this to the logarithmic distribution, with parameter p, is possible. Frullani integrals and Laplace transforms are encountered. Graphical representations of some of the more significant distributions are given. These include probability functions, regions of validity, and three dimensional representations of probability functions showing the response to variation of parameters when two parameters are involved.

4814 Packet-switched intercommunication network for distributed memory, parallel processor computers. Napolitano, L.M. Jr. To Dept. of Energy. 1990. Filed date 26 Feb 1990. USAA patent application 7-660,50. 44p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-76DP00789. Order Number DE93002002. Source: OSTI; NTIS; GPO Dep.

The Lambda network is a single stage, packet-switched interprocessor communication network for a distributed memory, parallel processor computer. Its design arises from the desired network characteristics of minimizing mean and maximum packet transfer time, local routing, expandability, deadlock avoidance, and fault tolerance. The network is based on fixed degree nodes and has $O(\log_{2n})$ mean and maximum packet transfer distances where n is the number of processors. The routing method is detailed, as are methods for expandability, deadlock avoidance, and fault tolerance.

4815 (PNL-SA–21186) **Planning and managing distributed computing resources.** Fox, J.C. Pacific Northwest Lab., Richland, WA (United States). Aug 1992. 9p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. (CONF-920895–1: 33. Association for Energy Systems, Operations, and Programming conference, Oak Ridge, TN (United States), 18-20 Aug 1992). Order Number DE93001513. Source: OSTI; NTIS; GPO Dep.

This paper explains the approach that the Pacific Northwest Laboratory is taking to address the planning and management issues raised by the distribution of computing resources throughout the organization. The issues are outlined, the annual planning and management process is described, and its effectiveness in addressing the issues is assessed.

4816 (SAND–92-1063C) **A different view of the fault tree forest.** Daniel, S.L.; Kunsman, D.M. Sandia National Labs., Albuquerque, NM (United States). [1992]. 7p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-76DP00789. (CONF-930116–7: Probabilistic safety assessment international topical meeting, Clearwater Beach, FL (United States), 27-29 Jan 1993). Order Number DE93002472. Source: OSTI; NTIS; GPO Dep.

A different approach to obtaining an exact solution to a complex fault tree is presented. The fault tree is complex because it contains a large number of AND gates and many high-order multiple output gates.

4817 (SAND–92-7281) **PC software overview.** Fox, E.T. (EG and G Energy Measurements, Inc., Albuquerque, NM (United States)); Kissock, P.S. Sandia National Labs., Albuquerque, NM (United States); EG and G Energy Measurements, Inc., Albuquerque, NM (United States). Oct 1992. 68p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-76DP00789. Order Number DE93003228. Source: OSTI; NTIS; GPO Dep.

The laptop PC is used by the Annunciator maintenance personnel to generate the site configuration and the sunrise/sunset times data files, to upload software files and data files to the host computer, to download the historical log file from the host, to maintain the historical log database, and to generate reports. This manual describes the organization and functionality of the software as well as generation mechanisms for development and target environments.

4818 (SAND–92-8625) **Teaching polymers to fold.** Judson, R.S. Sandia National Labs., Livermore, CA (United States). Oct 1992. 18p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-76DP00789. Order Number DE93002670. Source: OSTI; NTIS; GPO Dep.

A new method is presented for predicting folding pathways of polymers. The folding pathway is described as a generic program or sequence of logical steps of such a form that a computer can carry them out to produce a folded structure. A Genetic Algorithm (GA) is used to learn specific sequences or folding pathways that carry a denatured conformation into a target final conformation. The method is demonstrated on a model 2-dimensional polymer for which the global energy minimum is known. The GA learns a program that will fold a denatured polymer into its global energy minimum conformation.

4819 (SOL–92-6) **Bracketing to speed convergence illustrated on the von Newmann algorithm for finding a feasible solution to a linear program with a convexity contraint: Technical report.** Dantzig, G.B. Stanford Univ., CA (United States).

Systems Optimization Lab. Oct 1992. 12p. Sponsored by USDOE, Washington, DC (United States); Electric Power Research Inst., Palo Alto, CA (United States); National Science Foundation, Washington, DC (United States). DOE Contract FG03-92ER25116. Grant DMS-8913089;Grant RP8010-09. Order Number DE93002660. Source: OSTI; NTIS; GPO Dep.

Analogous to gunners firing trial shots to bracket a target in order to adjust direction and distance, we demonstate that it is sometimes faster not to apply an algorithm directly, but to roughly approximately solve several perturbations of the problem and then combine these rough approximations to get an exact solution. To find a feasible solution to an m-equation linear program with a convexity constraint, the von Neumann Algorithm generates a sequence of approximate solutions which converge very slowly to the right hand side b^0. However, it can be redirected so that in the first few iterations it is guaranteed to move rapidly towards the neighborhood of one of m + 1 perturbed right hand sides $\hat{b}^i$, then redirected in turn to the next $\hat{b}^i$. Once within the neighborhood of each $\hat{b}^i$, a weighted sum of the approximate solutions. $\bar{x}^i$ yields the exact solution of the unperturbed problem where the weights are found by solving a system of m + 1 equations in m + 1 unknowns. It is assumed an $r > 0$ is given for which the problem is feasible for all right hand sides b whose distance $||b - b^0||_2 \leq r$. The feasible solution is found in less than $4(m+ 1)^3/r^2$ iterations. The work per iteration is $\delta mn + 2m + n + 9$ multiplications plus $\delta mn + m + n + 9$ additions or comparisons where δ is the density of nonzero coeffients in the matrix.

4820 (SSCL-Preprint–8-Rev.A) **Discovering graphics in LATEX documents: Preprint 8, Revision A.** Damrau, J. Superconducting Super Collider Lab., Dallas, TX (United States). Jul 1992. 11p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC35-89ER40486. (CONF-9207164–1-Rev.A: 13. annual TEX users group meeting, Portland, OR (United States), 27-30 Jul 1992). Order Number DE93003318. Source: OSTI; NTIS; INIS; GPO Dep.

This paper attempts to share all information obtained in researching the graphics inclusion in LATEX, from using the picture environment to using EPS graphics, briefly discussing how graphics enter user documents, the graphics packages available to accomplish graphics inclusion, and the various uses of the \special command for the SSCL printers.

4821 (UCRL-CR–111574) **DIDS site selection.** Heberlein, T. (Haystack Labs., Inc., Austin, TX (United States)); Pon, K. Lawrence Livermore National Lab., CA (United States); California Univ., Davis, CA (United States); Haystack Labs., Inc., Austin, TX (United States). Oct 1990. 4p. Sponsored by USDOE, Washington, DC (United States); Department of Defense, Washington, DC (United States). DOE Contract W-7405-ENG-48. (DIDS–91-01). Order Number DE93001610. Source: OSTI; NTIS (US Sales Only); GPO Dep.

This document specifies the target system to be monitored by the prototype Distributed Intrusion Detection System (DIDS). The first part of this document summarizes information obtained through site visits to two US Air Force (USAF) computer facilities. The next section discusses the target system selected for the DIDS prototype and details the reasoning behind the selection.

4822 (UCRL-CR–111575) **DIDS preliminary design.** Smaha, S. (Haystack Labs., Inc., Austin, TX (United States)). Lawrence Livermore National Lab., CA (United States); California Univ., Davis, CA (United States). Div. of Computer Science; Haystack Labs., Inc., Austin, TX (United States). Dec 1990. 35p. Sponsored by USDOE, Washington, DC (United States); Department of Defense, Washington, DC (United States). DOE Contract W-7405-ENG-48. (DIDS–91-02). Order Number DE93001611. Source: OSTI; NTIS (US Sales Only); GPO Dep.

This report is submitted in partial fulfillment of the requirements of work performed for the US Air Force Cryptologic Support Center, San Antonio, Texas. It outlines in detail, the preliminary design of the Distributed Intrusion Detection System (DIDS). DIDS is a software system residing on heterogeneous host computers and on a dedicated hardware platform. These entities interact via local area network to detect intrusive behavior on the host computers.

4823 (UCRL-CR–111576) **DIDS evaluation criteria and technical issues.** Brentano, J. (California Univ., Davis, CA (United States)). Lawrence Livermore National Lab., CA (United States); California Univ., Davis, CA (United States); Haystack Labs., Inc., Austin, TX (United States). Dec 1990. 53p. Sponsored by USDOE, Washington, DC (United States); Department of Defense, Washington, DC (United States). DOE Contract W-7405-ENG-48. (DIDS–91-03). Order Number DE93001613. Source: OSTI; NTIS (US Sales Only); GPO Dep.

This report is submitted in partial fulfillment of the requirements of work performed for the US Air Force Cryptologic Support Center, San Antonio, Texas. It describes the technical issues involved in the design of the Distributed Intrusion Detection System (DIDS) and compares these issues vis-a-vis their implementation in DIDS versus several other intrusion detection systems. Issues include: host monitoring and audits; network monitoring, aggregation of audit information; implementation of an attack model; and applications of expert system technology to intrusion detection. This document is excerpted from the author's Master of Science thesis in computer Science, submitted to the University of California at Davis.

4824 (UCRL-ID–111966) **1-D slab solidification TOPAZ2D comparison to analytical solution.** Smith, J. Lawrence Livermore National Lab., CA (United States). Oct 1992. 40p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. Order Number DE93003337. Source: OSTI; NTIS; GPO Dep.

The objective of this project was to compare the numerical simulation of a 1-D slab solidification problem to the analytical solution found in Carslaw and Jaeger (1980), using absolute error as the basis of comparison. Three time steps, four element densities and two methods of accounting for latent heat produced a total of twenty-four data sets.

4825 (UCRL-JC–109361) **Complexity optimized vector quantization: A neural network approach.** Buhmann, J. (Lawrence Livermore National Lab., CA (United States)); Kuehnel, H. Lawrence Livermore National Lab., CA (United States). 31 Jan 1992. 12p. Sponsored by USDOE, Washington, DC (United States); Department of Defense, Washington, DC (United States); German Federal Ministry of Science and Technology (Germany). DOE Contract W-7405-ENG-48. Grant ITR-8800-H1;Grant 88-0274. (CONF-9203200–1: Data compression conference, Snowbird, UT (United States), 24-26 Mar 1992). Order Number DE93001304. Source: OSTI; NTIS; GPO Dep.

We discuss a vector quantization strategy which jointly optimizes distortion errors and complexity costs. A maximum entropy estimation of the vector quantization cost function yields an optimal codebook size, the reference vectors and the assignment frequencies. We compare different complexity measures for the design of image compression algorithms which quantize wavelet decomposed images. An online version of complexity optimized vector quantization is implemented by an artificial neural network with winner-take-all connectivity. Our approach establishes unifying framework for different quantization methods like K-means clustering and its fuzzy version, entropy constrainted vector quantization or self-organizing topological maps and competitive neural networks.

4826 (UCRL-JC–111428) **PDDP: A parallel data distribution preprocessor.** Warren, K.H. Lawrence Livermore National Lab., CA (United States). Jul 1992. 25p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. (CONF-930117–4: 26. Hawaiian international conference on system science: biotechnology computing track, Kauai, HI (United States), 5-8 Jan 1993). Order Number DE92040400. Source: OSTI; NTIS; GPO Dep.

The current goal of the computer hardware industry is to produce computers featuring hundreds, even thousands of processors, that achieve Teraflop results. When such a massive number of processors are used, data proximity becomes a key concern. Existing mature software will not produce Teraflop levels on the new architecture. PDDP, a Fortran preprocessor under development at LLNL, is directed to a massively parallel machine that features loosely coupled distributed shared memory and that offers the convenience of programming a shared virtual address space. PDDP

distributes shared data among processors in a semi-automatic manner. The distributed data is then treated in parallel by the processors. We say semi-automatic because PDDP makes uses of FORTRAN 90 array syntax and a Fortran D method of distribution to achieve this parallelization. Synchronization is handled by PFP, a split-join model that uses the team concept of parallel computing and is the target model for PDDP. The BBN TC2000 computer is the developmental platform for PDDP. The TC2000 has 128 processors, each with its own local memory, cache, and a contribution to the shared memory.

4827 (UCRL-LR–111809) **Designing for scientific data analysis: From practice to prototype.** Springmeyer, R.R. Lawrence Livermore National Lab., CA (United States). Sep 1992. 210p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. Order Number DE93001509. Source: OSTI; NTIS; GPO Dep.

Thesis submitted to University of California, Davis.

Designers charged with creating tools for processes foreign to their own experience need a reliable source of application knowledge. This dissertation presents an empirical study of the scientific data analysis process in order to inform the design of tools for this important aspect of scientific computing. Interaction analysis and contextual inquiry methods were adapted to observe scientists analyzing their own data and to characterize the scientific dam analysis process. The characterization exposed elements of the process outside the conventional scientific visualization model that defines data analysis in terms of image generation. Scientists queried for quantitative information, made a variety of comparisons, applied mathematics, managed data, and kept records. Many such elements were only indirectly supported by computer. A detailed description of the scientific data analysis process was developed to provide a broad-based foundation of understanding which is rooted in empirical fact, reasonably comprehensive, and applicable to a range of scientific environments. The characterization of scientific data analysis led to design recommendations for improving the support of this process. The application of the results was demonstrated with the design, development, and study of a prototype tool for an inadequately supported scientific dam analysis element. Data culling is the identification and extraction of areas of interest in large scientific data sets. Modern workstation-based analysis tools require manageable subsets of data, but dam culling is not well supported. A prototype tool was designed and developed to explore a quantitative rather than image-based approach to identifying such subsets. Physicist end-users participated throughout the design, development, and evaluation process. The results of evaluations in the field established conditions under which a number-based approach to data selection effectively supplements an image-based approach.

9903 Information Handling

Refer also to citation(s) 2718, 3042, 3049, 3120, 3441, 3665, 3773, 4053, 4056, 4057, 4058, 4105, 4368, 4469, 4623, 4786

4828 (ANL/CP–76977) **Placing the camel's hump: The review process.** Caruthers, M.S. Argonne National Lab., IL (United States). 28 Jul 1992. 16p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-31109-ENG-38. (CONF-9209142–8: Institute of Electrical and Electronics Engineers (IEEE) international professional communications conference (IPCC): crossing frontiers, Santa Fe, NM (United States), 30 Sep 1992). Order Number DE92040740. Source: OSTI; NTIS; GPO Dep.

The old joke that a camel is a horse put together by a committee implies, of course, that anything done by committee is certain to be done badly. The miscommunication and lack of coordination endemic in committee work surely must result in a product that is unlovely and unsuitable for the task for which the committee intended it. And of all things under the sun, writing by committee surely is the least likely of all tasks to turn out well. I'm here to show you how writing by committee works–and works well–in my job. In my job as a technical editor at Argonne National Laboratory, I worked primarily in the Computing and Telecommunications Division (CTD), where I edited technical and scientific documents, newsletter articles, and marketing materials. Frequently, I did high-level edits, even generating some text of my own, in collaboration with computational scientists and technicians in my division. In this presentation, I call these people author-experts–i.e., people who were involved with the production of multi-author texts. I am going to take you step by step through the text writing and reviewing process that we employ to ensure error-free and usable texts for the Argonne audience: from secretary to nuclear physicist.

4829 (CTA-IEAV-NT–07/87) **International nuclear data centers and the Nuclear Data Center of the Instituto de Estudos Avancados.** Corcuera, R.P.; Nair, R.P.K.; Santos, R. dos. Centro Tecnico Aeroespacial (CTA-IEAv), Sao Jose dos Campos, SP (Brazil). Inst. de Estudos Avancados. Apr 1987. 4p. (In Portuguese). Order Number DE93608116. Source: OSTI; NTIS (US Sales Only); INIS.

This work describes the nuclear data center of the Instituto de Estudos Avancados in Brazil. The data are related to nuclear energy, theoretical physics, and experimental physics. (A.C.A.S.).

4830 (ES/ER/TM–39) **Data management plan for the Oak Ridge Environmental Information System, Version 1.1: Environmental Restoration Program.** Oak Ridge National Lab., TN (United States). 4 Aug 1992. 152p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. Order Number DE92041219. Source: OSTI; NTIS; INIS; GPO Dep.

The Data Management Plan (DMP) describes the data management objectives, system components, data base structure and contents, system maintenance, data processing, and user interface for the prototype phase of the Oak Ridge Environmental Information System (OREIS). The major goals of OREIS data management are to compile data of known quality, to maintain the integrity of the data base, and to provide data to users. The DMP defines the requirements, describes the responsibilities, and references the procedures for meeting the data management objectives. Emphasis is on management of measurement data and the associated metadata used to support its proper interpretation and legal defensibility. The DMP covers transmittal, processing, storage, and data access activities associated with OREIS. The OREIS data dictionary is provided as an appendix.

4831 (FAW-TR–92007) **A cooperative, natural language environmental information system.** Becker, R. (IBM Deutschland GmbH, Heidelberg (Germany). Inst. for Knowledge Based Systems (IKBS)); Kuepper, D.; Roesner, D.; Strobel, M. Ulm Univ. (Germany). Forschungsinstitut fuer Anwendungsorientierte Wissensverarbeitung (FAW). Apr 1992. 12p. (CONF-9209254–1: 12. world computer congress: From research to practice, Madrid (Spain), 7-11 Sep 1992). Order Number DE93728835. Source: OSTI; NTIS (US Sales Only).

This paper describes the extension of a natural language interface to relational databases with respect to its cooperative behavior. We argue that cooperative behavior is especially important for a complex domain such as environmental protection. In order to enrich traditional database reports our system- provides dialog-oriented features such as over-answering and handling of presupposition failure, as well as presentation-oriented features such as natural language responses and geographical maps. (orig.).

4832 (INIS-BR–3042) **Design and static simulation of secondary loop of small PWR nuclear power plants.** Martin Lopez, L.A.N. Sao Paulo Univ., SP (Brazil). Escola Politecnica. 1989 270p. (In Portuguese). Order Number DE93608118. Source: OSTI; NTIS (US Sales Only); INIS.

A computer program that has been developed with the purpose of making easier the decisions concerning the design of the secondary loop of small PWR nuclear power plants through numerical experiments of low running costs and short time is presented. Initially, the first part of the computer program is described. It aims to preliminarily design several major components of the secondary circuit from user-defined design conditions. Next, the second part of the computer program is presented. It simulates the steady state operation at part-load conditions of the preliminary design of the plant by generating and solving systems of simultaneous nonlinear algebraic equations, their number varying from 17 to 107. The

computer program has been tested for several application cases. The program results are discussed in the last part of the work, along with several aspects to be added to the program in future works. (author).

4833 (KAERI/TR–247/91) **Construction of a bibliographic information database for the nuclear engineering.** Kim, Tae Whan (Korea Atomic Energy Research Inst., Daeduk (Korea, Republic of)); Lim, Yeon Soo; Kwac, Dong Chul. Korea Atomic Energy Research Inst., Daeduk (Korea, Republic of). Dec 1991. 63p. (In Korean). Order Number DE93608117. Source: OSTI; NTIS (US Sales Only); INIS.

The major goal of the project is to develop a nuclear science database of materials that have been published in Korea and to establish a network system that will give relevant information to people in the nuclear industry by linking this system with the proposed National Science Technical Information Network. This project aims to establish a database consisted of about 1,000 research reports that were prepared by KAERI from 1979 to 1990. The contents of the project are as follows: 1. Materials Selection and Collection 2. Index and Abstract Preparation 3. Data Input and Transmission. This project is intended to achieve the goal of maximum utilization of nuclear information in Korea. (Author).

4834 (KFK–4867) **Nuclear data libraries for the treatment of sequential (x,n) reactions in fusion materials activation calculations.** Cierjacks, S.; Oblozinsky, P.; Rzehorz, B. Kernforschungszentrum Karlsruhe GmbH (Germany). Inst. fuer Materialforschung. Jul 1991. 25p. Order Number DE93729014. Source: OSTI; NTIS (US Sales Only); INIS.

The current status of nuclear data libraries produced or under development for the kinematically complete treatment of sequential (x,n) reactions in fusion materials activation calculations is discussed. The existing libraries allow complete treatment virtually of all isotopes from Z = 1 through 42 ($A \leq 100$) with half-lifes exceeding 1 day for primary neutron energies $E_n < 20$ MeV and secondary charged particles x = p,d and α with energies $E_x < 24$ MeV. Production cross sections of charged particles for primary (n,x) reactions are derived from the evaluated activation file REAC-ECN-5. For the corresponding normalized charged particle spectra we created the starter file KFKSPEC, fully based on nuclear-reaction model calculations and presently containing 12 300 spectra with about 300 000 data points. The same approach was adopted to create the starter file KFKXN for charged particle induced (x,n) cross sections that contains 1025 different reactions and 24 600 data points. A complete set of differential ranges for light charged particles was generated for all elements from hydrogen to uranium and is stored in the KFKSTOP file which has 11 040 data points. (orig.).

4835 (WHC-SA–1480) **Meeting the challenge of responding to stakeholder information needs: A program model.** Birkland, V.L. (Boeing Computer Services Co., Richland, WA (United States)). Westinghouse Hanford Co., Richland, WA (United States). Sep 1992. 5p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-87RL10930. (CONF-9210158–1: Infotech '92, Oak Ridge, TN (United States), 21-23 Oct 1992). Order Number DE93002047. Source: OSTI; NTIS; GPO Dep.

In a dynamic, changing environment, effective decision-making is reached at the lower levels of an organization. With this concept in mind, Westinghouse Hanford Company designed a comprehensive information release program to manage information as close as possible to the original source. This paper will describe that program and the issues associated with implementing its objectives: improve the release process to respond to stakeholder requirements and liability for noncompliance.

Corporate Author Index

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	Oak Ridge National Lab., Grand Junction, CO (United States)	
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AC05-84OT21400	**Oak Ridge K-25 Site, TN (United States)**	
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AC05-86OR21548	**MK-Ferguson Co., Weldon Spring, MO (United States)**	
	18:2831	DOE/OR/21548–228-Rev.1
AC05-91OR21949	**Bechtel National, Inc., Oak Ridge, TN (United States)**	
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	18:2833	DOE/OR/21949–342
	18:2834	DOE/OR/21949–343
	18:2835	DOE/OR/21949–344
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AC06-87RL10930	**Westinghouse Hanford Co., Richland, WA (United States)**	
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AC07-84ID12435	**Westinghouse Idaho Nuclear Co., Inc., Idaho Falls, ID (United States)**	
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AC07-88ID12698	**General Atomics, San Diego, CA (United States)**	
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AC08-87NV10594	**History Associates, Inc., Rockville, MD (United States)**	
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AC08-88NV10617	**EG and G Energy Measurements, Inc., Las Vegas, NV (United States)**	
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AC08-89NV10630	**Reynolds Electrical and Engineering Co., Inc., Las Vegas, NV (United States)**	
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AC08-90NV10845	**Nevada Univ., Reno, NV (United States). Water Resources Center**	
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AC09-76SR00001	**Du Pont de Nemours (E.I.) and Co., Aiken, SC (United States). Savannah River Lab.**	
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AC09-89SR18035	**Du Pont de Nemours (E.I.) and Co., Aiken, SC (United States). Savannah River Lab.**	
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AC09-92SR18220	**NUS Corp., Aiken, SC (United States)**	
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AC11-76PN00014	**Bettis Atomic Power Lab., West Mifflin, PA (United States)**	
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AC11-89PN38014	**Bettis Atomic Power Lab., West Mifflin, PA (United States)**	
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	Westinghouse Electric Corp., Idaho Falls, ID (United States)	
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AC12-76SN00052	**Knolls Atomic Power Lab., Schenectady, NY (United States)**	
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AC21-80ET17089	**Westinghouse Electric Corp., Pittsburgh, PA (United States). Science and Technology Center**	
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AC21-86MC23262	**Avco-Everett Research Lab., Inc., Everett, MA (United States)**	
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AC21-86MC23281	**National Renewable Energy Lab., Golden, CO (United States)**	
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AC21-87MC24012	**SRI International, Menlo Park, CA (United States)**	
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AC21-88MC24221	**International Fuel Cells Corp., South Windsor, CT (United States)**	
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AC21-88MC25020	**Lummus Crest, Inc., Bloomfield, NJ (United States)**	
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AC21-89MC26040	**Energy Research Corp., Danbury, CT (United States)**	
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AC21-91MC27393	**International Fuel Cells Corp., South Windsor, CT (United States)**	
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AC22-84PC70023	**UOP, Inc., Des Plaines, IL (United States). Signal UOP Research Center**	
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	UOP, Inc., Des Plaines, IL (United States). Technical Center	
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AC22-86PC90275	**Combustion Engineering, Inc., Windsor, CT (United States)**	
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AC22-87PC79887	**Ohio State Univ., Columbus, OH (United States). Dept. of Chemistry**	
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AC22-87PC79903	**Stanford Univ., CA (United States). High Temperature Gasdynamics Lab.**	
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AC22-88PC88818	**Hydrocarbon Research, Inc., Princeton, NJ (United States)**	
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AC22-88PC88943	**Fossil Energy Research Corp., Laguna Hills, CA (United States)**	
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AC22-89PC89757	**Lehigh Univ., Bethlehem, PA (United States). Dept. of Chemistry**	
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AC22-89PC89883	**Consolidation Coal Co., Library, PA (United States). Research and Development Dept.**	
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AC22-90BC14657	**Appalachian Oil and Natural Gas Research Consortium, Morgantown, WV (United States)**	
	18:2603	DOE/BC/14657–7
AC22-90PC90051	**National Renewable Energy Lab., Golden, CO (United States)**	
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AC22-91PC90027	**Bechtel Corp., San Francisco, CA (United States)**	
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AC22-91PC91052	**Hydrocarbon Research, Inc., Princeton, NJ (United States)**	
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AC34-90DP62349	**EG and G Rocky Flats, Inc., Golden, CO (United States). Rocky Flats Plant**	
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AC35-89ER40486	**Superconducting Super Collider Lab., Dallas, TX (United States)**	
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AI05-83ER53145	**Naval Research Lab., Washington, DC (United States). E.O. Hulburt Center for Space Research**	
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AI21-89MC26018	**National Inst. for Occupational Safety and Health, Morgantown, WV (United States)**	
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AI22-87PC79660	**Naval Civil Engineering Lab., Port Hueneme, CA (United States). Dept. of Energy and Environment**	
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AM79-89BP39833	**Brian Gard/William Lesh, Inc., Portland, OR (United States)**	
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AS05-78ER05030	**Rutgers–the State Univ., New Brunswick, NJ (United States)**	
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AS05-80ER10713	**Virginia Polytechnic Inst. and State Univ., Blacksburg, VA (United States). Dept. of Physics**	
	18:4542	DOE/ER/10713–T3

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AS05-80ER10742	Brookhaven National Lab., Upton, NY (United States)	
	18:3569	BNL–47545
	18:3642	BNL–47544
FC02-86CH10289	Pacific Wind Energy, Corvallis, OR (United States)	
	18:2948	DOE/CH/10289–T1
FC02-86CH10296	Westinghouse Electric Corp., Pittsburgh, PA (United States). Advanced Energy Systems Div.	
	18:2957	WAESD-TN–87-0028
FC02-86CH10311	Northern Power Systems, Moretown, VT (United States)	
	18:2949	DOE/CH/10311–T1
FC02-90CE40938	Texas A and M Univ., College Station, TX (United States). Texas Engineering Experiment Station	
	18:2623	DOE/CE/40938–2
FC07-91ID13042	Idaho Dept. of Health and Welfare, Boise, ID (United States)	
	18:4237	DOE/ID/13042–T4
FC07-91ID13074	Kansas State Univ., Manhattan, KS (United States)	
	18:3555	DOE/ID/13074–T5
FC21-86MC10637	North Dakota Univ., Grand Forks, ND (United States). Energy and Environmental Research Center	
	18:2968	DOE/MC/10637–3134
FC21-87MC24132	Ohio Power Co., Columbus, OH (United States)	
	18:2575	DOE/MC/24132–92/C0079
FC21-87MC24207	West Virginia Univ., Morgantown, WV (United States). Dept. of Statistics and Computer Science	
	18:4783	DOE/MC/24207–3007
	West Virginia Univ., Morgantown, WV (United States). Dept. of Mechanical and Aerospace Engineering	
	18:2576	DOE/MC/24207–2997
FC21-91MC27363	Tampa Electric Co., FL (United States)	
	18:2961	DOE/MC/27363–93/C0076
FC22-83FE60149	National Inst. for Petroleum and Energy Research, Bartlesville, OK (United States)	
	18:2600	NIPER–639
	18:2604	NIPER–633
FC22-87PC79796	Energy and Environmental Research Corp., Irvine, CA (United States)	
	18:2969	DOE/PC/79796–T28
FC22-90PC89653	Southern Co. Services, Inc., Birmingham, AL (United States)	
	18:2974	DOE/PC/89653–T5
FC22-90PC89658	Bethlehem Steel Corp., PA (United States)	
	18:2514	DOE/PC/89658–T3
	18:2515	DOE/PC/89658–T4
	18:2516	DOE/PC/89658–T5
FC22-91PC90545	Babcock and Wilcox Co., Alliance, OH (United States). Research and Development Div.	
	18:2960	CONF-921004–2
FG01-86CE26565	Ohio State Univ., Columbus, OH (United States)	
	18:3550	DOE/CE/26565–T1
FG01-89CE15427	Montana State Univ., Bozeman, MT (United States). Dept. of Chemical Engineering	
	18:3541	DOE/CE/15427–T14
FG01-90CE15460	Aikins (Warren A.), Longview, WA (United States)	
	18:2903	DOE/CE/15460–T8
FG01-90CE15479	Long (John B.), Sarasota, FL (United States)	
	18:2940	DOE/CE/15479–T4
FG01-90CE15488	PIPco, Inc., Southport, CT (United States)	
	18:2626	DOE/CE/15488–T7
FG01-90CE21002	Florida Solar Energy Center, Cape Canaveral, FL (United States)	
	18:3525	DOE/CE/21002–T1
FG01-91EW40017	Babcock and Wilcox Co., Apollo, PA (United States)	
	18:2829	DOE/EW/40017–T3
FG01-92CE15533	Energy Recovery Technology, Salt Lake City, UT (United States)	
	18:2628	DOE/CE/15533–T3
FG01-92CE15974	Nebraska Univ., Lincoln, NE (United States). Dept. of Electrical Engineering	
	18:3645	DOE/CE/15974–T1
FG02-84CH10201	Chicago Univ., IL (United States). Enrico Fermi Inst.	
	18:2912	DOE/CH/10201–T3
	18:2913	DOE/CH/10201–T4
FG02-84ER13227	Utah Univ., Salt Lake City, UT (United States). Dept. of Chemistry	
	18:3824	DOE/ER/13227–T5
FG02-84ER13247	Colorado Univ., Boulder, CO (United States)	
	18:2914	DOE/ER/13247–8
FG02-84ER13289	Harvard Univ., Cambridge, MA (United States). Dept. of Chemistry	
	18:3777	DOE/ER/13289–6
FG02-84ER13295	Pennsylvania State Univ., University Park, PA (United States)	
	18:3778	DOE/ER/13295–6
FG02-84ER45056	Connecticut Univ., Storrs, CT (United States)	
	18:3825	DOE/ER/45056–10
FG02-84ER45097	Northwestern Univ., Evanston, IL (United States)	
	18:3619	DOE/ER/45097–9
FG02-84ER45120	Seton Hall Univ., South Orange, NJ (United States). Dept. of Chemistry	
	18:3575	DOE/ER/45120–T1
	18:3793	DOE/ER/45120–T2
	18:3794	DOE/ER/45120–T3
FG02-84ER45130	Washington Univ., St. Louis, MO (United States). Dept. of Physics	
	18:3576	DOE/ER/45130–7
FG02-84ER53188	Missouri Univ., Rolla, MO (United States). Div. of Applied Plasma Physics	
	18:4663	DOE/ER/53188–9
FG02-85ER13323	Pennsylvania State Univ., University Park, PA (United States). Dept. of Chemistry	
	18:3780	DOE/ER/13323–7
FG02-85ER13406	Wisconsin Univ., Madison, WI (United States)	
	18:3781	DOE/ER/13406–7
FG02-85ER45204	Pennsylvania State Univ., University Park, PA (United States). Materials Research Lab.	
	18:3646	DOE/ER/45204–T5
FG02-85ER45214	Pennsylvania State Univ., University Park, PA (United States). Materials Research Lab.	
	18:3577	DOE/ER/45214–T5
FG02-85ER52118	California Univ., Los Angeles, CA (United States). Inst. of Plasma and Fusion Research	
	18:4755	UCLA/PPG–1323-Vol.1
FG02-85ER53194	Dartmouth Coll., Hanover, NH (United States)	
	18:4708	DOE/ER/53194–5

Contract No.	Abstract No.	Report No.
FG02-85ER53212	Wisconsin Univ., Madison, WI (United States)	
	18:4709	DOE/ER/53212–198
FG02-86ER13501	Arizona Univ., Tucson, AZ (United States). Dept. of Chemistry	
	18:3782	DOE/ER/13501–T2
FG02-86ER13603	Boston Univ., MA (United States). Dept. of Chemistry	
	18:3783	DOE/ER/13603–5
FG02-86ER40246	Lowell Univ., MA (United States). Radiation Lab.	
	18:4609	DOE/ER/40246–7
FG02-86ER45239	State Univ. of New York, Stony Brook, NY (United States). Research Foundation	
	18:3578	DOE/ER/45239–8
FG02-86ER45281	Miami Univ., Oxford, OH (United States)	
	18:3579	DOE/ER/45281–7
FG02-86ER53218	Wisconsin Univ., Madison, WI (United States)	
	18:4737	UW-CPTC–92-5
FG02-86ER53236	Grumman Aerospace Corp., Princeton, NJ (United States). Corporate Research Center	
	18:4711	DOE/ER/53236–T3
FG02-86ER60397	East Anglia Univ., Norwich (United Kingdom). Climatic Research Unit	
	18:4116	DOE/ER/60397–6
FG02-86ER60400	Missouri Univ., Columbia, MO (United States). Dept. of Chemistry	
	18:4279	DOE/ER/60400–6
FG02-86ER60417	Wisconsin Univ., Madison, WI (United States). Dept. of Medical Physics	
	18:4323	DOE/ER/60417–006
FG02-86ER60455	Oakland Univ., Rochester, MI (United States)	
	18:4324	DOE/ER/60455–T4
FG02-86ER60485	Atmospheric and Environmental Research, Inc., Cambridge, MA (United States)	
	18:4117	DOE/ER/60485–4
FG02-87ER13650	Syracuse Univ., NY (United States). Dept. of Chemical Engineering and Materials Science	
	18:3784	DOE/ER/13650–2
FG02-87ER13725	Northwestern Univ., Evanston, IL (United States). Dept. of Chemical Engineering	
	18:3785	DOE/ER/13725–6
FG02-87ER13732	Pennsylvania Univ., Philadelphia, PA (United States). Dept. of Chemistry	
	18:3617	DOE/ER/13732–6
FG02-87ER13781	Pittsburgh Univ., PA (United States)	
	18:3786	DOE/ER/13781–6
FG02-87ER40365	Indiana Univ., Bloomington, IN (United States)	
	18:4578	DOE/ER/40365–6
FG02-87ER45283	State Univ. of New York, Buffalo, NY (United States). Dept. of Physics and Astronomy	
	18:3622	DOE/ER/45283–11
FG02-87ER45294	Massachusetts Inst. of Tech., Cambridge, MA (United States). Dept. of Mechanical Engineering	
	18:3648	DOE/ER/45294–T4
FG02-87ER45295	Pennsylvania Univ., Philadelphia, PA (United States). Dept. of Materials Science and Engineering	
	18:3580	DOE/ER/45295–T2
FG02-87ER60533	Michigan Univ., Ann Arbor, MI (United States)	
	18:4326	DOE/ER/60533–5
FG02-88ER12810	Northwestern Univ., Evanston, IL (United States). Dept. of Mechanical Engineering	
	18:4779	DOE/ER/12810–1
FG02-88ER13825	Pennsylvania Univ., Philadelphia, PA (United States). Dept. of Chemical Engineering	
	18:3787	DOE/ER/13825–8
FG02-88ER13849	Rochester Univ., NY (United States)	
	18:3788	DOE/ER/13849–5
FG02-88ER13855	City Univ. of New York, NY (United States). Research Foundation	
	18:3789	DOE/ER/13855–T1
FG02-88ER13880	Missouri Univ., Columbia, MO (United States)	
	18:3790	DOE/ER/13880–5
FG02-88ER13919	Clarkson Univ., Potsdam, NY (United States). Dept. of Chemical Engineering	
	18:4674	DOE/ER/13919–5
FG02-88ER13949	Illinois Univ., Urbana, IL (United States)	
	18:4050	DOE/ER/13949–4
FG02-88ER25052	New York Univ., NY (United States). Courant Inst. of Mathematical Sciences	
	18:4781	DOE/ER/25052–T1
FG02-88ER40405	Minnesota Univ., Minneapolis, MN (United States). School of Physics and Astronomy	
	18:4611	DOE/ER/40405–5
FG02-88ER40412	Purdue Univ., Lafayette, IN (United States). Dept. of Physics	
	18:4544	DOE/ER/40412–T1
FG02-88ER45337	Minnesota Univ., Minneapolis, MN (United States). Corrosion Research Center	
	18:3623	DOE/ER/45337–5
FG02-88ER45347	Ohio State Univ. Research Foundation, Columbus, OH (United States)	
	18:4690	DOE/ER/45347–32
	Ohio State Univ., Columbus, OH (United States)	
	18:3649	DOE/ER/45347–51
FG02-88ER45364	Pennsylvania State Univ., University Park, PA (United States). Materials Research Lab.	
	18:3577	DOE/ER/45214–T5
FG02-88ER60639	Michigan Univ., Ann Arbor, MI (United States). Div. of Nuclear Medicine	
	18:4280	DOE/ER/60639–5
FG02-88ER60655	Johns Hopkins Univ., Baltimore, MD (United States). School of Hygiene and Public Health	
	18:4384	DOE/ER/60655–T1
FG02-88ER60668	Pennsylvania State Univ., University Park, PA (United States). Dept. of Chemistry	
	18:4327	DOE/ER/60668–5
FG02-89ER12899	Louisiana State Univ., Baton Rouge, LA (United States)	
	18:4638	DOE/ER/12899–3
FG02-89ER13996	Michigan Univ., Ann Arbor, MI (United States). Dept. of Chemistry	
	18:3669	DOE/ER/13996–3
FG02-89ER14017	Rochester Univ., NY (United States). Dept. of Physics and Astronomy	
	18:3618	DOE/ER/14017–4
FG02-89ER14079	Colorado School of Mines, Golden, CO (United States). Center for Wave Phenomena	
	18:4435	DOE/ER/14079–21
FG02-89ER40516	American Inst. of Physics, New York, NY (United States). Center for History of Physics	
	18:4469	DOE/ER/40516–2

Contract No.	Abstract No.	Report No.
FG02-89ER52158	Wisconsin Univ., Madison, WI (United States). Fusion Technology Inst.	
	18:4744	DOE/ER/52158–3
FG02-89ER60775	Utah Univ., Salt Lake City, UT (United States). Dept. of Biology	
	18:4180	DOE/ER/60775–T1
FG02-89ER60791	Princeton Univ., NJ (United States). School of Engineering	
	18:3940	DOE/ER/60791–1
FG02-89ER69017	Massachusetts Univ., Amherst, MA (United States)	
	18:4121	DOE/ER/69017–4
FG02-90CE15982	Loyola Univ., Chicago, IL (United States)	
	18:3455	DOE/CE/15982–T1
FG02-90CE15983	Innovative Products Research and Services, Inc., Lexington, MA (United States)	
	18:3479	DOE/CE/15983–T1
FG02-90CE15984	Technology Targeting, Inc., Salt Lake City, UT (United States)	
	18:3456	DOE/CE/15984–T1
FG02-90ER13030	Illinois Univ., Urbana, IL (United States). Dept. of Nuclear Engineering	
	18:3101	CONF-920146–7
FG02-90ER14135	Battelle, Columbus, OH (United States)	
	18:3574	DOE/ER/14135–1
FG02-90ER14136	Syracuse Univ., NY (United States)	
	18:3938	DOE/ER/14136–2
FG02-90ER14145	Colorado Univ., Boulder, CO (United States)	
	18:4670	DOE/ER/14145–T2
FG02-90ER25086	Colorado Univ., Denver, CO (United States)	
	18:4639	DOE/ER/25086–T1
FG02-90ER40542	Institute for Advanced Study, Princeton, NJ (United States)	
	18:4487	DOE/ER/40542–73
FG02-90ER40544	Arizona Univ., Tucson, AZ (United States)	
	18:4025	DOE/ER/40544–1
FG02-90ER45427	Argonne National Lab., IL (United States)	
	18:3612	ANL/CP–77482
FG02-90ER54104	Pennsylvania State Univ., University Park, PA (United States)	
	18:4664	DOE/ER/54104–1
FG02-90ER61019	Colorado Univ., Boulder, CO (United States). Cooperative Inst. for Research in Environmental Sciences	
	18:4236	DOE/ER/61019–3
FG02-90ER61085	Michigan Univ., Ann Arbor, MI (United States)	
	18:4328	DOE/ER/61085–2
FG02-90ER61091	Michigan Univ., Ann Arbor, MI (United States)	
	18:4281	DOE/ER/61091–T1
FG02-91ER14190	Michigan Univ., Ann Arbor, MI (United States). Dept. of Chemistry	
	18:3791	DOE/ER/14190–1
FG02-91ER14226	Columbia Univ., New York, NY (United States)	
	18:3792	DOE/ER/14226–1
FG02-91ER20053	Nebraska Univ., Lincoln, NE (United States)	
	18:2904	DOE/ER/20053–1
FG02-91ER25107	Society for Industrial and Applied Mathematics (SIAM), Philadelphia, PA (United States). Inst. for Mathematics and Society	
	18:4782	DOE/ER/25107–1
FG02-91ER40615	Drexel Univ., Philadelphia, PA (United States). Dept. of Physics	
	18:4026	DOE/ER/40615–2
FG02-91ER40628	Brookhaven National Lab., Upton, NY (United States)	
	18:4562	BNL–47932
FG02-91ER40651	Rockefeller Univ., New York, NY (United States)	
	18:4470	DOE/ER/40651–2
	18:4546	DOE/ER/40651–3
FG02-91ER40653	Pennsylvania State Univ., University Park, PA (United States)	
	18:4027	DOE/ER/40653–1
FG02-91ER40654	Harvard Univ., Cambridge, MA (United States). High Energy Physics Lab.	
	18:4471	DOE/ER/40654–2
FG02-91ER40671	Princeton Univ., NJ (United States)	
	18:4472	DOE/ER/40671–1
FG02-91ER40676	Boston Univ., MA (United States). Dept. of Physics	
	18:4473	DOE/ER/40676–2
FG02-91ER40682	Carnegie-Mellon Univ., Pittsburgh, PA (United States)	
	18:4455	DOE/ER/40682–20
	18:4488	DOE/ER/40682–10
	18:4489	DOE/ER/40682–19
	18:4512	DOE/ER/40682–15
	18:4547	DOE/ER/40682–5
	Carnegie-Mellon Univ., Pittsburgh, PA (United States). Dept. of Physics	
	18:4474	DOE/ER/40682–17
	18:4513	DOE/ER/40682–16
	18:4567	DOE/ER/40682–3
FG02-91ER40684	Northwestern Univ., Evanston, IL (United States)	
	18:4475	DOE/ER/40684–1
FG02-91ER40690	Ohio State Univ., Columbus, OH (United States). Dept. of Physics	
	18:4477	DOE/ER/40690–1
FG02-91ER45439	Illinois Univ., Urbana, IL (United States). Materials Research Lab.	
	18:3565	DOE/ER/45439–132
FG02-91ER45461	Pennsylvania State Univ., University Park, PA (United States)	
	18:3821	DOE/ER/45461–1
FG02-91ER54110	California Univ., Los Angeles, CA (United States). Inst. of Plasma and Fusion Research	
	18:4755	UCLA/PPG–1323-Vol.1
FG02-91ER75637	Franklin Inst., Philadelphia, PA (United States). Science Museum	
	18:4182	DOE/ER/75637–1
FG02-91ER75682	Kansas State Univ., Manhattan, KS (United States)	
	18:3459	DOE/ER/75682–1-Pt.2
	18:3460	DOE/ER/75682–1-Pt.3
	Kansas State Univ., Manhattan, KS (United States). Inst. for Social and Behavioral Research	
	18:3481	DOE/ER/75682–1-PT.1
	18:3482	DOE/ER/75682–1-Pt.5
FG02-91NP00119	Virginia Polytechnic Inst. and State Univ., Blacksburg, VA (United States)	
	18:4765	DOE/NP/00119–2-Vol.1
FG02-92ER25120	Indiana Univ., Bloomington, IN (United States). Inst. for Scientific Computing and Applied Mathematics	
	18:3939	DOE/ER/25120–1
FG02-92ER30196	E and S Environmental Chemistry, Inc., Corvallis, OR (United States)	
	18:4178	DOE/ER/30196–1
	18:4235	DOE/ER/30196–2
FG02-92ER40715	Massachusetts Univ., Amherst, MA (United States)	
	18:4478	DOE/ER/40715–1

Contract No.	Abstract No.	Report No.
FG02-92ER40716	Connecticut Univ., Storrs, CT (United States)	
	18:4490	DOE/ER/40716–1
FG02-92ER61364	State Univ. of New York, Albany, NY (United States). Atmospheric Sciences Research Center	
	18:4119	DOE/ER/61364–1
FG02-92ER61365	Wisconsin Univ., Madison, WI (United States)	
	18:4120	DOE/ER/61365–1
FG03-85ER13317	California Univ., Santa Barbara, CA (United States). Dept. of Chemistry	
	18:3779	DOE/ER/13317–T3
FG03-85ER51069	California Univ., Los Angeles, CA (United States)	
	18:4740	DOE/ER/51069–T2
	18:4741	DOE/ER/51069–T5
	18:4742	DOE/ER/51069–T6
FG03-86ER13571	SRI International, Menlo Park, CA (United States). Molecular Physics Lab.	
	18:3900	DOE/ER/13571–T2
FG03-86ER45279	California Univ., Davis, CA (United States). Dept. of Mechanical Engineering	
	18:3621	DOE/ER/45279–1
FG03-86ER52124	California Univ., Los Angeles, CA (United States)	
	18:4743	DOE/ER/52124–T2
FG03-86ER52126	California Univ., Los Angeles, CA (United States). Inst. of Plasma and Fusion Research	
	18:4755	UCLA/PPG–1323-Vol.1
FG03-86ER53225	California Univ., Los Angeles, CA (United States)	
	18:4710	DOE/ER/53225–T6
	Princeton Univ., NJ (United States). Plasma Physics Lab.	
	18:4732	PPPL-CFP–2758
FG03-87ER13673	Stanford Univ., CA (United States). Dept. of Chemical Engineering	
	18:3937	DOE/ER/13673–T3
FG03-87ER40323	California Univ., Berkeley, CA (United States). Dept. of Physics	
	18:4024	DOE/ER/40323–T6
FG03-88ER13910	California Univ., Los Angeles, CA (United States)	
	18:3901	DOE/ER/13910–T2
	18:3902	DOE/ER/13910–T3
	California Univ., Los Angeles, CA (United States). Dept. of Mechanical, Aerospace and Nuclear Engineering	
	18:3899	CONF-8910289–7
FG03-90ER61062	California Univ., Santa Barbara, CA (United States)	
	18:4118	DOE/ER/61062–T1
FG03-91ER54115	California Univ., Los Angeles, CA (United States). Dept. of Mechanical, Aerospace and Nuclear Engineering	
	18:3624	DOE/ER/54115–T2
FG03-91ER61125	California Univ., Berkeley, CA (United States). Dept. of Chemistry	
	18:4275	DOE/ER/61125–2
FG03-92ER25116	Stanford Univ., CA (United States). Systems Optimization Lab.	
	18:4819	SOL–92-6
FG03-92ER40689	California Univ., Santa Cruz, CA (United States)	
	18:4476	DOE/ER/40689–T1
FG05-83OR21389	CONEG Policy Research Center, Inc., Washington, DC (United States)	
	18:2861	DOE/OR/21389–37
	Tellus Inst., Inc., Boston, MA (United States)	
	18:2907	DOE/OR/21389–38
FG05-84ER45113	Virginia Univ., Charlottesville, VA (United States). Dept. of Physics	
	18:3620	DOE/ER/45113–T4
FG05-85ER13456	Tennessee Univ., Knoxville, TN (United States). Dept. of Physics	
	18:4669	DOE/ER/13456–44
FG05-85ER40200	Texas Univ., Austin, TX (United States). Center for Particle Theory	
	18:4468	DOE/ER/40200–298
FG05-85ER40226	Carnegie-Mellon Univ., Pittsburgh, PA (United States)	
	18:4489	DOE/ER/40682–19
FG05-85ER45208	Florida State Univ., Tallahassee, FL (United States)	
	18:3647	DOE/ER/45208–8
FG05-86ER13591	Tennessee Univ., Knoxville, TN (United States)	
	18:3668	DOE/ER/13591–6
FG05-86ER60464	Bowman Gray School of Medicine, Winston-Salem, NC (United States)	
	18:4325	DOE/ER/60464–6
FG05-87ER	California Univ., Los Angeles, CA (United States). Inst. of Plasma and Fusion Research	
	18:4755	UCLA/PPG–1323-Vol.1
FG05-87ER13711	Texas A and M Univ., College Station, TX (United States). Center for Tectonophysics	
	18:4434	DOE/ER/13711–T1
FG05-87ER40310	Texas A and M Univ., College Station, TX (United States)	
	18:4023	DOE/ER/40310–T2
FG05-87ER40330	Georgia Inst. of Tech., Atlanta, GA (United States). School of Physics	
	18:4583	DOE/ER/40330–64
FG05-87ER40343	Texas Univ., Austin, TX (United States). Dept. of Physics	
	18:4610	DOE/ER/40343–6
FG05-87ER40361	Oak Ridge National Lab., TN (United States)	
	18:4581	CONF-9205108–17
FG05-88ER13821	Texas Univ., Austin, TX (United States)	
	18:4673	DOE/ER/13821–6
FG05-88ER13838	Maryland Univ., College Park, MD (United States)	
	18:4115	DOE/ER/13838–5
FG05-88ER13846	Maryland Univ., College Park, MD (United States)	
	18:4780	DOE/ER/13846–4
FG05-88ER40390	Virginia Univ., Charlottesville, VA (United States). Dept. of Physics	
	18:4543	DOE/ER/40390–5
FG05-88ER40418	Maryland Univ., College Park, MD (United States). Dept. of Chemistry	
	18:4584	DOE/ER/40418–5
FG05-88ER40454	Virginia Polytechnic Inst. and State Univ., Blacksburg, VA (United States). Dept. of Physics	
	18:4545	DOE/ER/40454–T2
FG05-89ER14005	Duke Univ., Durham, NC (United States)	
	18:4274	DOE/ER/14005–T2
FG05-89ER14090	Maryland Univ., Baltimore, MD (United States). Dept. of Electrical Engineering	
	18:3909	DOE/ER/14090–3
FG05-89ER40530	Oak Ridge National Lab., TN (United States)	
	18:4580	CONF-920113–9

Contract No.	Abstract No.	Report No.
FG05-89ER60743	National Research Council, Washington, DC (United States). Water Science and Technology Board	
	18:4179	DOE/ER/60743–3
FG05-90ER60988	Tennessee Univ., Knoxville, TN (United States). Center for Environmental Biotechnology	
	18:4181	DOE/ER/60988–T1
FG05-91ER40617	Brookhaven National Lab., Upton, NY (United States)	
	18:4562	BNL–47932
FG05-91ER75609	Research Communications Ltd., Dedham, MA (United States)	
	18:4760	DOE/ER/75609–T1
FG06-90ER54095	Princeton Univ., NJ (United States). Plasma Physics Lab.	
	18:4730	PPPL-CFP–2756
FG07-86ER13572	Idaho Univ., Moscow, ID (United States). Dept. of Chemical Engineering	
	18:3936	DOE/ER/13572–5
FG07-88ER12824	Tennessee Univ., Knoxville, TN (United States)	
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4662	18:4224	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93001727	MF-502
4676	18:4109	OSTI; NTIS; GPO Dep.	E 1.99:	DE93000315	MF-502
BONN-ME–					
92-02	18:4015	OSTI; NTIS (US Sales Only); INIS		DE93728870	
BIS-ET–					
10/91-REV-1	18:2725	OSTI; NTIS (US Sales Only); INIS		DE93728837	
CBPF-NF–					
032/91	18:4607	OSTI; NTIS (US Sales Only); INIS		DE93608479	
036/91	18:4528	OSTI; NTIS (US Sales Only); INIS		DE93608348	
037/91	18:4479	OSTI; NTIS (US Sales Only); INIS		DE93608243	
040/91	18:4600	OSTI; NTIS (US Sales Only); INIS		DE93608449	
041/91	18:4563	OSTI; NTIS (US Sales Only); INIS		DE93608376	
CDTN-DETR-NT–					
248/89	18:2990	OSTI; NTIS (US Sales Only); INIS		DE93607748	
249/89	18:2984	OSTI; NTIS (US Sales Only); INIS		DE93607699	
CDTN-LABRE-NT–					
004/80	18:3099	OSTI; NTIS (US Sales Only); INIS		DE93607809	
CDTN/LR–					
29	18:3890	OSTI; NTIS (US Sales Only); INIS		DE93606615	
CEBAF-PR–					
92-017	18:4566	*See* DOE/ER/40150–200			
CERN–					
6519/92	18:4531	*See* DESY–92-078			
CLOR–					
121/D	18:4110	OSTI; NTIS (US Sales Only); INIS		DE93607158	
CMU–					
04422	18:4474	*See* DOE/ER/40682–17			
CMU-HEP–					
92-04	18:4455	*See* DOE/ER/40682–20			
92-05	18:4489	*See* DOE/ER/40682–19			
92-08	18:4567	*See* DOE/ER/40682–3			
92-10	18:4547	*See* DOE/ER/40682–5			
92-15	18:4488	*See* DOE/ER/40682–10			
92-20	18:4512	*See* DOE/ER/40682–15			
92-21	18:4513	*See* DOE/ER/40682–16			
CMWG–					
2	18:4772	*See* ORNL/M–2490			
CNEN-DIN–					
04/83	18:4300	OSTI; NTIS (US Sales Only); INIS		DE93607296	
CNEN-DR–					
136/87	18:2991	OSTI; NTIS (US Sales Only); INIS		DE93607751	
141/88	18:3034	OSTI; NTIS (US Sales Only); INIS		DE93608102	
CNEN-DR-GAN-NT–					
02/86	18:4775	OSTI; NTIS (US Sales Only); INIS		DE93608121	
02/89	18:3100	OSTI; NTIS (US Sales Only); INIS		DE93607810	
03/87	18:2992	OSTI; NTIS (US Sales Only); INIS		DE93607749	
07/87	18:2993	OSTI; NTIS (US Sales Only); INIS		DE93607750	
COLO-HEP–					
293	18:4560	*See* SLAC-PUB–5974			
CONF-730907–		(3. international congress of the International Radiation Protection Association meeting; Washington, DC (United States); 9-14 Sep 1973)			
1	18:4109	*See* BNWL-SA–4676			
CONF-8409421–		(Seminar on the use of research reactors in fundamental and applied sciences; Tajoura (Libyan Arab Jamahiriya); 16 Sep 1984)			
	18:3285	*See* INIS-mf–13375			
CONF-8510519–		(26. Brazilian Congress on Chemistry; Fortaleza (Brazil); 6-11 Oct 1985)			
	18:2690	*See* IPEN-PUB–356			
	18:2691	*See* IPEN-PUB–357			
	18:3807	*See* IPEN-PUB–355			
CONF-8807219–		(7. Gondwana symposium; Sao Paulo (Brazil); 18 Jul 1988)			
	18:3737	*See* INIS-BR–2938			

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CONF-8910199–		(European symposium on elastic-plastic fracture mechanics (EPFM); Freiburg (Germany); 9-12 Oct 1989)			
2	18:2965	*See* ENEL-CRTN-G11–89-10			
CONF-8910289–		(Western States Section meeting of the Combustion Institute; Livermore, CA (United States); 23-24 Oct 1989)			
7	18:3899	OSTI; NTIS; GPO Dep.	E 1.99:	DE93002224	MF-406
CONF-8911335–		(2. research co-ordination meeting on the use of nuclear and nuclear-related techniques in the study of environmental pollution asociated with solid wastes; JAKARTA (Indonesia); 20-24 Nov 1989)			
	18:3686	*See* IAEA-NAHRES–6			
CONF-8911339–		(3. research co-ordination meeting on nuclear techniques for toxic elements in foodstuffs; Jakarta (Indonesia); 20 Nov 1989)			
	18:3673	*See* IAEA-NAHRES–3			
CONF-900243–		(Workshop on major SSC detectors; Tucson, AZ (United States); 18-23 Feb 1990)			
	18:4025	*See* DOE/ER/40544–1			
CONF-9003331–		(IAEA consultants' meeting of the participants in the international network of nuclear structure and decay data evaluators; Kuwait (Kuwait); 10 Mar 1990)			
	18:4588	*See* INDC(NDS)–250/G,ND			
CONF-9004367–		(Workshop on online documentation in the supercomputing environment; Colorado Springs, CO (United States); 3-6 Apr 1990)			
Summs.	18:4807	*See* LA–11990-C			
CONF-900487–		(11. international corrosion congress: innovation and technology transfer for corrosion control and the 159th event of the European Federation of Corrosion; Florence (Italy); 2-6 Apr 1990)			
1	18:3586	*See* ETDE-IT–92-91			
CONF-9005340–		(10. International days on Expert Systems and their Applications; Avignon (France); 28 May - 1 jun 1990)			
1	18:3447	*See* ETDE-IT–92-83			
CONF-9005433–		(US-Brazil Expert's Workshop on Spherical Torus Experiments; Sao Jose dos Campos (Brazil); 1-9 May 1990)			
	18:4718	*See* INPE–5256			
CONF-9005434–		(Wind turbine control system strategy and problems; London (United Kingdom); 3-4 May 1990)			
1	18:2950	*See* ETDE-IT–92-77			
CONF-9005435–		(7. annual meeting of the Southeast Regional Health Physics Society chapters; Charleston, SC (United States); 3-5 May 1990)			
1	18:3082	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93002123	MF-406
2	18:3083	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93002122	MF-405; MF-406
CONF-900804–		(International topical meeting on fast reactor safety; Snowbird, UT (United States); 12-16 Aug 1990)			
35	18:3067	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93002127	MF-405
CONF-9009469–		(Convegno nazionale AIM; Ancona (Italy); 25-27 Sep 1990)			
2	18:3583	*See* ENEL-CRTN-G11–90-07			
CONF-900971–		(12. European conference on thermophysical properties: ECTP-12; Vienna (Austria); 24-28 Sep 1990)			
4	18:3946	*See* ETDE-IT–92-75			
CONF-901008–		(Fall meeting of the Minerals, Metals and Materials Society (TMS); Detroit, MI (United States); 7-11 Oct 1990)			
16	18:3609	*See* WSRC-MS–90-104			

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CONF-9011308–		(2. research co-ordination meeting on applications of stable isotope tracers in human nutrition research; Bangalore (India); 26-29 Nov 1990)			
	18:4303	*See* IAEA-NAHRES–8			
CONF-910154–		(10. American Society of Mechanical Engineers (ASME) wind energy symposium; Houston, TX (United States); 20-24 Jan 1991)			
2	18:2956	*See* SAND–92-1607C			
CONF-9103265–		(7. annual report of the Research Program for Air Pollution Prevention Measures of Kernforschungszentrum Karlsruhe GmbH; Karlsruhe (Germany); 5-7 Mar 1991)			
Vol.1	18:4387	*See* KFK-PEF–80-Vol.1			
CONF-910430–		(93. annual meeting and exposition of the American Ceramic Society (ACerS); Cincinnati, OH (United States); 28 Apr - 2 may 1991)			
33	18:4064	*See* MLM–3764(OP)			
CONF-9105387–		(Seminar on ground water modelling; Espoo (Finland); 9 May 1991)			
	18:4210	*See* VTT-SYMP–126			
CONF-9105393–		(International Energy Agency (IEA) executive committee meeting; Stockholm (Sweden); 1-2 May 1991)			
1	18:2906	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93001710	MF-247
CONF-9105395–		(Workshop on cycle chemistry in fossil fuel power plants; Copenhagen (Denmark); 21-22 May 1991)			
1	18:2966	*See* ENEL-CRTN-T6–91-12			
CONF-9106351–		(7. convegno nazionale Gruppo Italiano Frattura (IGF); Florence (Italy); 13-14 Jun 1991)			
4	18:3584	*See* ENEL-CRTN-T11–91-10			
CONF-9106410–		(5. international symposium on catalyst deactivation; Evanston, IL (United States); 14-16 Jun 1991)			
1	18:2976	*See* ENEL-CRTN-T6–91-08			
CONF-9106411–		(1. research co-ordination meeting on assessment of environmental exposure to mercury in selected human populations as studied by nuclear and other techniques; Vienna (Austria); 10-13 Jun 1991)			
	18:3707	*See* IAEA-NAHRES–7			
CONF-9107104–		(5. international conference on precipitation scavenging and atmosphere surface exchange process; Richland, WA (United States); 15-19 Jul 1991)			
24	18:4108	*See* BNL–47743			
CONF-910802–		(World congress of the International Solar Energy Society; Denver, CO (United States); 19-23 Aug 1991)			
7	18:2941	*See* ENEL-CRTN-G8–91-01			
8	18:3543	*See* ENEL-CRTN-G14–91-02			
CONF-9108221–		(1991 symposium on some mathematical question in biology; San Antonio, TX (United States); 8 Aug 1991)			
1	18:3464	OSTI; NTIS; GPO Dep.	E 1.99:	DE93000429	MF-400
CONF-9108224–		(Technical committee meeting on new developments in uranium exploration, resources, production and demand; Vienna (Austria); 26-29 Aug 1991)			
	18:2720	*See* IAEA-TECDOC–650			
CONF-910836–		(19. Stanford Linear Accelerator Center (SLAC) summer institute on particle physics; Stanford, CA (United States); 5-16 Aug 1991)			
	18:4558	*See* SLAC–398			
CONF-910921–		(2. European conference on accelerators in applied research and technology; Frankfurt am Main (Germany); 3-7 Sep 1991)			
	18:4014	*See* BESSY-TB–166/91			

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CONF-9109435–		(Technical committee meeting/workshop on demonstration and review of expert system prototypes; Springfields (United Kingdom); 30 Sep - 4 oct 1991)			
	18:4799	*See* IAEA-TECDOC–660			
CONF-9109443–		(International symposium on radionuclides in the study of marine processes (Radstomp 91); Norwich (United Kingdom); 9-14 Sep 1991)			
1	18:4239	*See* ETDE-IT–92-85			
CONF-9109444–		(5. international meeting on the behaviour of hydraulic machinery; Milan (Italy); Sep 1991)			
1	18:2908	*See* ETDE-IT–92-96			
CONF-9109445–		(3. research co-ordination meeting on the use of nuclear and nuclear-related techniques in the study of environmental pollution associated with solid wastes; Vienna (Austria); 10-13 Sep 1991)			
	18:3716	*See* IAEA-NAHRES–9			
CONF-911001–		(International conference on fast reactor systems and fuel cycles; Kyoto (Japan); 27 Oct - 1 nov 1991)			
27	18:3020	*See* ANL/CP–72053			
CONF-9110326–		(European conference on laser interaction with matter (ECLIM); Warsaw (Poland); 21-25 Oct 1991)			
	18:4735	*See* SINS–2120/P-5/PP/A			
CONF-9110402–		(Conference on constructed wetlands for water quality improvement; Pensacola, FL (United States); 21-24 Oct 1991)			
2	18:3549	OSTI; NTIS; GPO Dep.	E 1.99:	DE93001641	MF-402
CONF-9110430–		(1991 atmospheric radiation measurement science team meeting; Washington, DC (United States); 28 Oct 1991)			
1	18:4107	*See* ANL/CP–77379			
CONF-9110438–		(3. electric insulation workshop; Bilbao (Spain); 29-30 Oct 1991)			
1	18:3448	*See* ETDE-IT–92-87			
CONF-9110439–		(3. international symposium on monitoring of gaseous pollutants by tunable diode lasers; Freiburg im Breisgau (Germany); 17-18 Oct 1991)			
1	18:3797	*See* GKSS–91/E/95			
CONF-9111215–		(ANNIE '91: artificial neural networks in engineering conference; St. Louis, MO (United States); 10-13 Nov 1991)			
1	18:3068	OSTI; NTIS; GPO Dep.	E 1.99:	DE93002232	MF-405
CONF-9111271–		(International conference on powder metallurgy (PM) aerospace materials (PM AERO '91); Lausanne (Switzerland); 4-6 Nov 1991)			
	18:3587	*See* GKSS–91/E/92			
CONF-9112143–		(Alimentazione elettrica delle grandi aree urbane; Milan (Italy); 10-11 Dec 1991)			
1	18:3551	*See* ETDE-IT–92-93			
2	18:3505	*See* ETDE-IT–92-94			
CONF-9112144–		(Press seminar of the GSF Project 'Information Environment'; Berlin (Germany); 3-4 Dec 1991)			
	18:4762	*See* INIS-mf–14085			
CONF-920113–		(8. winter workshop on nuclear dynamics; Jackson Hole, WY (United States); 18-25 Jan 1992)			
9	18:4580	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93002359	MF-413
CONF-920119–		(17. workshop on geothermal reservoir engineering; Stanford, CA (United States); 29-31 Jan 1992)			
5	18:2944	*See* LBL–32140			

Report Number	Abstract Number	Source of Availability	GPO Dep.	Order Number	Distribution Category
CONF-920146–		(ASTM international symposium on small specimen test techniques and their applications to nuclear reactor vessel thermal annealing and plant life extension; New Orleans, LA (United States); 29-31 Jan 1992)			
7	18:3101	OSTI; NTIS; GPO Dep.	E 1.99:	DE93002119	MF-406
CONF-9202139–		(Rifiuti urbani ed industriali; Milan (Italy); 10-12 Feb 1992)			
1	18:2742	*See* ETDE-IT–92-79			
CONF-9202140–		(6. European symposium on semiconductor detectors: New developments on radiation detectors; Milan (Italy); 24-26 Feb 1992)			
	18:4044	*See* DESY–92-060			
CONF-920311–		(10. international conference on plasma-surface interactions in controlled fusion devices; Monterey, CA (United States); 30 Mar - 3 apr 1992)			
26	18:4727	*See* PPPL–2855			
CONF-920315–		(3. European particle accelerator conference (EPAC-3): Accelerators for special applications; Berlin (Germany); 24-28 Mar 1992)			
	18:3971	*See* GSI–92-25(prepr.)			
CONF-9203154–		(27. Moriond meeting: Quantum Chromodynamics (QCD) and high energy hadronic interactions; Les Arcs (France); 22-28 Mar 1992)			
	18:4535	*See* DESY–92-090			
CONF-9203164–		(International workshop on the physics and techniques of secondary nuclear beams; Dourdan (France); 23-25 Mar 1992)			
	18:4616	*See* GSI–92-36(prepr.)			
CONF-9203167–		(International symposium on micromechanics: homogenization, heterogenization and strength; La Jolla, CA (United States); 27-29 Mar 1992)			
	18:4530	*See* DESY–92-073			
CONF-9203181–		(Workshop on harmonic oscillators; Baltimore, MD (United States); 25-28 Mar 1992)			
2	18:4449	*See* LBL–32101			
CONF-9203189–		(Latin American energy industry: new opportunities for growth through international investment and trade; La Jolla, CA (United States); 8-10 Mar 1992)			
	18:3478	OSTI; NTIS; GPO Dep.	E 1.99:	DE93001385	MF-900
CONF-9203200–		(Data compression conference; Snowbird, UT (United States); 24-26 Mar 1992)			
1	18:4825	*See* UCRL-JC–109361			
CONF-9203204–		(1. annual report of the project environment and health of Kernforschungszentrum Karlsruhe GmbH (KfK); Karlsruhe (Germany); 18-19 Mar 1992)			
	18:4411	*See* KFK-PUG–4			
CONF-9203206–		(Recycling of cadmium and selenium from photovoltaic modules and manufacturing wastes; Golden, CO (United States); 11-12 Mar 1992)			
	18:2938	*See* BNL–47787			
CONF-920331–		(International industrial symposium on the super collider; New Orleans, LA (United States); 4-6 Mar 1992)			
59	18:3990	*See* BNL–47942			
CONF-920402–		(1992 Material Research Society (MRS) spring meeting; San Francisco, CA (United States); 27 Apr - 2 may 1992)			
58	18:3659	*See* LBL–32470			
62	18:3601	*See* LBL–32830			
65	18:3600	*See* LBL–32829			
CONF-9204120–		(Soft-x-ray projection lithography topical meeting; Monterey, CA (United States); 6-8 Apr 1992)			
4	18:3994	*See* BNL–48033			

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CONF-9204125–		(B factories: state of the art in accelerators, detectors, and physics; Stanford, CA (United States); 6-10 Apr 1992)			
14	18:4557	*See* LBL–32861			
17	18:4011	*See* SLAC-PUB–5919			
CONF-9204199–		(3. research co-ordination meeting on applications of stable isotope tracers in human nutrition research; Houston, TX (United States); 6-9 Apr 1992)			
	18:4317	*See* IAEA-NAHRES–10			
CONF-9204205–		(Symposium on application of geophysics to engineering and environmental problems; Oakbrook, IL (United States); 26-29 Apr 1992)			
1	18:4170	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93001369	MF-403
2	18:4171	OSTI; NTIS; !NIS; GPO Dep.	E 1.99:	DE93001363	MF-406; MF-403
CONF-9204207–		(Organic acid modeling and model validation workshop; Corvallis, OR (United States); 9-10 Apr 1992)			
Summ.	18:4178	*See* DOE/ER/30196–1			
CONF-9204210–		(1992 Zeuthen workshop on elementary particle theory: Deep inelastic scattering; Teupitz (Germany); 6-10 Apr 1992)			
	18:4533	*See* DESY–92-085			
CONF-920431–		(Meeting on new horizons in radiation protection and shielding; Pasco, WA (United States); 26 Apr - 1 may 1992)			
29	18:4605	*See* WHC-SA–1430			
CONF-920508–		(14. symposium on biotechnology for fuels and chemicals; Gatlinburg, TN (United States); 11-15 May 1992)			
5	18:2862	*See* ANL/CP–77167			
CONF-9205108–		(International conference on nuclear structure at high angular momentum; Ottawa (Canada); 18-21 May 1992)			
16	18:4595	*See* UCRL-JC–109942			
17	18:4581	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93001706	MF-413
CONF-920517–		(3. international symposium on high temperature corrosion and protection of materials - 180. event of the European Federation of Corrosion; Les Embiez (France); 25-29 May 1992)			
1	18:3585	*See* ENEL-CRTN-T11–92-02			
CONF-9205210–		(2. annual conference on electronics for future colliders; Chestnut Ridge, NY (United States); 19-21 May 1992)			
4	18:4016	*See* BNL–47904			
5	18:4018	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93002422	MF-414
CONF-9205234–		(Workshop on hadron structure from photoreactions at intermediate energies; Brookhaven, NY (United States); 28-29 May 1992)			
	18:4526	*See* BNL–47972			
CONF-9205241–		(1. technology/communications conference: tech transfer outreach; Richland, WA (United States); 19-21 May 1992)			
	18:3483	*See* PNL-SA–21348			
CONF-9205247–		(International workshop on squeezed states; Moscow (Russian Federation); 25-29 May 1992)			
2	18:4465	*See* LBL–32695			
CONF-9205255–		(NEA specialists meeting on fission product nuclear data; Tokyo (Japan); 25 May 1992)			
	18:4612	*See* ECN-RX–92-023			
CONF-9205257–		(4. Society for Industrial and Applied Mathematics (SIAM) conference on optimization; Chicago, IL (United States); 11-13 May 1992)			
Absts.	18:4782	*See* DOE/ER/25107–1			
CONF-9205258–		(QUARKS '92; Zvenigorod (Russian Federation); 11-16 May 1992)			
1	18:4508	*See* LA-UR–92-3073			

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CONF-9205260--		(International workshop on final focus and interaction regions of next generation linear colliders; Stanford, CA (United States); 2-6 May 1992)			
	18:3981	*See* SLAC--405			
CONF-9205261--		(FOREST '92: 2nd international symposium on environmental studies of tropical rain forests; Rio de Janeiro (Brazil); 24-29 May 1992)			
1	18:4172	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93001370	MF-402
CONF-9205263--		(17. Suffolk County Science Teachers Association awards; Smithtown, NY (United States); 20 May 1992)			
1	18:4758	*See* BNL--47744			
CONF-920555--		(4. international spring seminar on nuclear physics: the building blocks of nuclear structure; Amalfi (Italy); 18-22 May 1992)			
3	18:4579	*See* BNL--47889			
CONF-9206193--		(Advanced accelerator concepts workshop; Port Jefferson, NY (United States); 14-20 Jun 1992)			
15	18:3992	*See* BNL--47970			
16	18:3993	*See* BNL--48004			
17	18:3970	*See* BNL--47974			
CONF-9206202--		(NATO advanced study institute on statics and dynamics of alloy phase transformations; Rhodes (Greece); 21 Jun - 3 jul 1992)			
4	18:3570	*See* BNL--47976			
CONF-920621--		(1. Pacific Rim international conference on advanced materials and processing; Hangzhou (China); 23-27 Jun 1992)			
1	18:3571	OSTI; NTIS; GPO Dep.	E 1.99:	DE93001644	MF-404
CONF-9206222--		(International conference on advanced technology and particle physics; Como (Italy); 22-26 Jun 1992)			
3	18:4042	*See* SSCL-Preprint--155			
CONF-9206227--		(15. international conference on neutrino physics; Granada (Spain); 7-13 Jun 1992)			
3	18:4573	*See* LBL--32485			
CONF-9206270--		(Use and calibration of the Kern ME 5000 mekometer; Stanford, CA (United States); 18-19 Jun 1992)			
	18:4009	*See* SLAC--403			
CONF-9206275--		(Nobel symposium on heavy ion spectroscopy and QED effects in atomic systems; Saltsjoebaden (Sweden); 29 Jun - 3 jul 1992)			
	18:4647	*See* GSI--92-60(prepr.)			
CONF-9206280--		(Workshop on QCD vacuum structure; Paris (France); 1-5 Jun 1992)			
2	18:4562	*See* BNL--47932			
CONF-9206281--		(ICFA workshop on AC superconductivity; Tsukuba (Japan); 23-25 Jun 1992)			
3	18:3996	*See* FNAL/C--92/238			
CONF-9206287--		(36. Brazilian congress on ceramic; Caxambu (Brazil); 7 Jun 1992)			
	18:3630	*See* INPE--5372			
CONF-9206290--		(6. international conference on domain decomposition methods in science and engineering; Como (Italy); 14-21 Jun 1992)			
2	18:3945	*See* SAND--92-1996C			
CONF-9206293--		(Towards a major atmospheric Cherenkov detector for TeV astro/particle physics; Palaiseau (France); 11-12 Jun 1992)			
1	18:4462	*See* LA-UR--92-3132			
CONF-9206294--		(3. NSF-QEWB workshop on plasma science; New York, NY (United States); 4 Jun 1992)			
1	18:3969	*See* BNL--47888			
CONF-9206297--		(International symposium on optical fabric testing and surface evaluation; Tokyo (Japan); 6 Jun 1992)			
1	18:4004	*See* LBL--32560			

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CONF-9206301–		(16. annual larval fish conference; Kingston, RI (United States); 16-19 Jun 1992)			
1	18:4234	OSTI; NTIS; GPO Dep.	E 1.99:	DE93001365	
CONF-9206302–		(QCD - 20 years later workshop; Aachen (Germany); 9-13 Jun 1992)			
1	18:4524	*See* SLAC-PUB–5917			
CONF-9206304–		(15. surface and interface research meeting; Berkeley, CA (United States); 19 Jun 1992)			
1-Rev.1	18:3819	*See* UCRL-JC–110655-Rev.1			
CONF-920664–		(7. international conference on boundary element technology; Albuquerque, NM (United States); 3-5 Jun 1992)			
2	18:4203	*See* LBL–32021			
CONF-920706–		(International conference on high energy accelerators; Hamburg (Germany); 20-24 Jul 1992)			
39	18:3974	*See* SLAC-PUB–5928			
40	18:3986	*See* BNL–47102			
41	18:3978	*See* FNAL/C–92/241			
42	18:3997	*See* FNAL/C–92/240			
43	18:3987	*See* BNL–47602			
44	18:3988	*See* BNL–47620			
CONF-9207102–		(Institute of Nuclear Materials Management (INMM) annual meeting; Orlando, FL (United States); 19-22 Jul 1992)			
70	18:2851	*See* WHC-SA–1466			
CONF-9207152–		(Society of Photo-Optical Instrumentation Engineers (SPIE) mathematical methods in medical imaging; San Diego, CA (United States); 22-23 Jul 1992)			
1	18:4286	*See* LBL–32488			
CONF-9207156–		(International Astronomical Union (IAU) colloquium 139 on new perspectives on stellar pulsation and pulsating variable stars; Victoria (Canada); 7-11 Jul 1992)			
2	18:4463	*See* LA-UR–92-3144			
CONF-9207157–		(1992 Cargese magnetic turbulence and transport workshop; Cargese (France); 6-12 Jul 1992)			
1	18:4737	*See* UW-CPTC–92-5			
CONF-9207159–		(10. detonation symposium; Boston, MA (United States); Jul 1992)			
1	18:4063	*See* LA-UR–92-2915			
CONF-9207160–		(United States-Japan seminar on electronic structure and fermiology of high-Tc superconductors; Sendai (Japan); Jul 1992)			
1	18:3613	*See* BNL–47934			
CONF-9207164–		(13. annual TEX users group meeting; Portland, OR (United States); 27-30 Jul 1992)			
1-Rev.A	18:4820	*See* SSCL-Preprint–8-Rev.A			
CONF-920722–		(International conference on martensitic transformations; Monterey, CA (United States); 20-24 Jul 1992)			
4	18:3608	*See* UCRL-JC–111359			
CONF-920735–		(10. international conference on vacuum ultraviolet radiation physics; Paris (France); 27-31 Jul 1992)			
4	18:3607	*See* UCRL-JC–108837			
CONF-920748–		(US Department of Energy contractors review meeting on fuel cells; Morgantown, WV (United States); 14-15 Jul 1992)			
23	18:3515	*See* DOE/METC/C–92/7026			
CONF-920792–		(Society of Photo-Optical Instrumentation Engineers (SPIE) international symposium on optical applied science and engineering; San Diego, CA (United States); 19-24 Jul 1992)			
33	18:3667	*See* ANL/CP–77398			
34	18:3985	*See* ANL/CP–77394			
38	18:4263	*See* BNL–47954			
39	18:4017	*See* BNL–47955			

Report Number	Abstract Number	Source of Availability	GPO Dep.	Order Number	Distribution Category
CONF-920799–		(Review of progress in quantitative non destructive evaluation (NDE); La Jolla, CA (United States); 19-24 Jul 1992)			
2	18:3625	*See* EGG-M–92280			
CONF-920801–		(27. intersociety energy conversion engineering conference; San Diego, CA (United States); 3-7 Aug 1992)			
27	18:3451	*See* PNL-SA–20388			
28	18:3452	*See* PNL-SA–21073			
CONF-920802–		(Applied superconductivity conference; Chicago, IL (United States); 23-28 Aug 1992)			
16	18:3634	*See* LA-UR–92-3054			
24	18:4699	*See* SAND–92-1913C			
25	18:3612	*See* ANL/CP–77482			
27	18:4005	*See* LBL–32790			
33	18:4696	*See* LBL–32150			
CONF-920808–		(American Institute of Chemical Engineers (AIChE) summer national meeting; Minneapolis, MN (United States); 9-12 Aug 1992)			
11	18:2773	*See* PNL-SA–21215			
12	18:2602	*See* UCRL-JC–109621			
CONF-9208109–		(16. international LINAC conference; Ottawa (Canada); 23-28 Aug 1992)			
63	18:4003	*See* LA-UR–92-2720			
68	18:4012	*See* SLAC-PUB–5950			
CONF-9208114–		(American Nuclear Society meeting; Jackson Hole, WY (United States); 16-19 Aug 1992)			
5	18:3031	*See* PNL-SA–20524			
CONF-9208117–		(1992 Energy Facility Contractors Group (EFCOG) safety analysis workshop; Salt Lake City, UT (United States); 11-13 Aug 1992)			
17	18:3933	*See* Y/EN–4661			
CONF-9208135–		(International conference on the physics of strongly coupled plasmas; Rochester, NY (United States); 17-21 Aug 1992)			
4	18:4467	*See* UCRL-JC–111946			
CONF-9208142–		(14. international free electron laser conference; Kobe (Japan); 23-28 Aug 1992)			
6	18:3991	*See* BNL–47964			
7	18:3984	*See* ANL/CP–76107			
13	18:3975	*See* SLAC-PUB–5948			
CONF-920815–		(204. American Chemical Society (ACS) national meeting; Washington, DC (United States); 23-28 Aug 1992)			
10	18:3774	*See* PNL-SA–21259			
11	18:3606	*See* TVA-Bull–Z-311			
CONF-9208150–		(27. annual meeting of the Microbeam Analysis Society (MAS) (United States) and the 19th annual meeting of the Microscopical Society of Canada (MSC); Boston, MA (United States); Aug 1992)			
1	18:4676	*See* BNL–48003			
CONF-9208155–		(9. international congress on photosynthesis; Nagoya (Japan); 30 Aug - 5 sep 1992)			
2	18:4262	*See* ANL/CP–76567			
CONF-9208157–		(Arsenic and mercury workshop on removal, recovery, treatment and disposal; Alexandria, VA (United States); 17-20 Aug 1992)			
1	18:4173	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93000442	MF-402
CONF-9208160–		(7. international conference on x-ray absorption fine structure; Kobe (Japan); 23-29 Aug 1992)			
1	18:4695	*See* LA-UR–92-3057			
2	18:4653	*See* BNL–47995			
3	18:3569	*See* BNL–47545			
4	18:3642	*See* BNL–47544			
CONF-9208161–		(2. bifurcations and chaos workshop on dynamical measures of complexity and chaos; Bryn Mawr, PA (United States); 13-15 Aug 1992)			
1	18:4809	*See* LA-UR–92-2972			

Report Number	Abstract Number	Source of Availability	GPO Dep.	Order Number	Distribution Category
CONF-9208162--		(19. annual European meeting on atmospheric studies by optical methods; Kiruna (Sweden); 10-14 Aug 1992)			
1	18:4461	*See* LA-UR-92-3079			
CONF-9208163--		(5. international conference on shallow impurities in semiconductors; Kobe (Japan); 5-8 Aug 1992)			
1	18:4675	*See* LBL-32714			
CONF-9208164--		(6. symmetries in science; Bregenz (Austria); 2-7 Aug 1992)			
1	18:4810	*See* LA-UR-92-3200			
CONF-9208165--		(5. international conference on high pressure in semiconductor physics; Kyoto (Japan); 18-21 Aug 1992)			
1	18:3662	*See* SAND-92-2006C			
CONF-9208167--		(International workshop on world inventory; Wageningen (Netherlands); 24-27 Aug 1992)			
1	18:4174	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93001367	MF-402
CONF-9208168--		(7. symmetries in science: spectrum generating algebras and dynamic symmetries in physics; Nakajo (Japan); 28-31 Aug 1992)			
1	18:4577	*See* BNL-47935			
CONF-9208170--		(6. organic free radicals symposium; Noordwijkerhout (Netherlands); 23-28 Aug 1992)			
1	18:3815	*See* PNL-SA-21119			
CONF-920819--		(Annual meeting of the Electron Microscopy Society (EMS) of America; Boston, MA (United States); 16-21 Aug 1992)			
23	18:3772	*See* LBL-32129			
CONF-920828--		(American Council for an Energy-Efficient Economy (ACEEE) summer study on energy efficiency in buildings; Pacific Grove, CA (United States); 30 Aug - 5 sep 1992)			
19	18:3531	*See* PNL-SA-21094			
20	18:3522	*See* BNL-47990			
CONF-920837--		(26. international IUPAP conference on high energy physics; Dallas, TX (United States); 6-12 Aug 1992)			
	18:4539	*See* DESY-92-106			
16	18:3976	*See* SLAC-PUB-5955			
19	18:4527	*See* BNL-48118			
20	18:4559	*See* SLAC-PUB-5902			
21	18:4010	*See* SLAC-PUB-5899			
CONF-920849--		(16. annual Nuclear Information and Records Management Association symposium: shared information - golden gateway to progress; San Francisco, CA (United States); 30 Aug - 2 sep 1992)			
2	18:3120	*See* EGG-M-92072			
CONF-920851--		(Spectrum '92: nuclear and hazardous waste management international topical meeting; Boise, ID (United States); 23-27 Aug 1992)			
73	18:2772	*See* PNL-SA-20912			
74	18:4764	*See* PNL-SA-20881			
76	18:2797	*See* WSRC-MS-92-108			
77	18:2796	*See* WSRC-MS-91-555			
78	18:2823	*See* PNL-SA-20978			
79	18:2771	*See* PNL-SA-20710			
80	18:4208	*See* PNL-SA-20750			
82	18:2846	*See* PNL-SA-20623			
CONF-920895--		(33. Association for Energy Systems, Operations, and Programming conference; Oak Ridge, TN (United States); 18-20 Aug 1992)			
1	18:4815	*See* PNL-SA-21186			
CONF-920905--		(10. international symposium on the packaging and transportation of radioactive materials: PATRAM '92; Yokohama (Japan); 13-18 Sep 1992)			
2	18:3928	*See* SAND-92-1859C			
23	18:3924	*See* SAND-91-2630C			
24	18:2717	*See* SAND-91-2627C			

Report Number	Abstract Number	Source of Availability	GPO Dep.	Order Number	Distribution Category
26	18:2697	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93000446	MF-603
31	18:2716	*See* SAND–91-2600C			
33	18:3925	*See* SAND–91-2682C			
34	18:2718	*See* SAND–91-2691C			
38	18:3911	*See* GA-A–20763			
40	18:3913	*See* GA-A–20770			
41	18:3912	*See* GA-A–20764			
CONF-9209103–		(European research conference on nuclear physics: prospects for heavy ion inertial fusion; Aghia Pelaghia (Greece); 27 Sep - 1 oct 1992)			
1	18:4738	*See* BNL–47989			
CONF-920913–		(14. international conference on plasma physics and controlled nuclear fusion research; Wuerzburg (Germany); 30 Sep - 7 oct 1992)			
15	18:4752	*See* LBL–32213			
16	18:4729	*See* PPPL-CFP–2755			
17	18:4730	*See* PPPL-CFP–2756			
18	18:4703	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93001638	MF-426
CONF-9209142–		(Institute of Electrical and Electronics Engineers (IEEE) international professional communications conference (IPCC): crossing frontiers; Santa Fe, NM (United States); 30 Sep 1992)			
8	18:4828	*See* ANL/CP–76977			
CONF-9209158–		(10. symposium on turbulence and diffusion; Portland, OR (United States); 29 Sep - 2 oct 1992)			
5	18:4144	*See* PNL-SA–21231			
6	18:4252	*See* PNL-SA–21163			
CONF-920916–		(3. international conference and exhibition of the world congress on superconductivity; Munich (Germany); 14-19 Sep 1992)			
2	18:3614	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93001707	MF-404
CONF-9209160–		(International symposium on energy, environment and information management; Argonne, IL (United States); 15-18 Sep 1992)			
11	18:4106	*See* ANL/CP–77199			
13	18:3477	*See* ANL/CP–77470			
20	18:4105	*See* ANL/CP–76983			
CONF-9209162–		(21. North American Thermal Analysis Society meeting; Atlanta, GA (United States); 13-16 Sep 1992)			
2	18:4065	*See* MLM–3765(OP)			
CONF-9209163–		(6. American Meteorological Society conference on mountain meteorology; Portland, OR (United States); 29 Sep - 2 oct 1992)			
2	18:4143	*See* PNL-SA–20899			
3	18:4142	*See* PNL-SA–20898			
4	18:2947	*See* PNL-SA–21181			
CONF-9209173–		(22. International conference on alpine meteorology; Toulouse (France); 7-11 Sep 1992)			
3	18:4141	*See* PNL-SA–20711			
CONF-9209181–		(International Atomic Energy Agency (IAEA) technical committee meeting on tokamak plasma biasing; Montreal (Canada); 8-10 Sep 1992)			
2	18:4712	*See* GA-A–21041			
3	18:4731	*See* PPPL-CFP–2757			
4	18:4732	*See* PPPL-CFP–2758			
CONF-9209184–		(The International Society for Optical Engineering (SPIE) meeting; Boston, MA (United States); 8-11 Sep 1992)			
5	18:4046	*See* UCRL-JC–111211			
CONF-9209200–		(8. international conference on ion beam modification of materials; Heidelberg (Germany); 7-11 Sep 1992)			
5	18:4683	*See* LA-UR–92-2913			
6	18:3640	*See* PNL-SA–20885			

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CONF-9209201–		(Application of fluidized-bed combustion for power generation utility conference; Boston, MA (United States); 23-25 Sep 1992)			
2	18:2577	*See* DOE/METC/C–93/7032			
CONF-920921–		(6. international symposium on small particles and inorganic clusters; Chicago, IL (United States); 16-22 Sep 1992)			
3	18:4660	*See* ANL/CP–774			
CONF-9209213–		(Forecasting and planning process; Kansas City, MO (United States); 22 Sep 1992)			
1	18:4759	OSTI; NTIS; GPO Dep.	E 1.99:	DE92041017	MF-350
CONF-9209227–		(Symposium on magnetic ultrathin films, multilayers, and surfaces; Lyon (France); 7-10 Sep 1992)			
3	18:3568	*See* ANL/CP–76028			
CONF-9209229–		(Industrial and engineering chemistry (I&EC) special symposium of the American Chemical Society (ACS); Atlanta, GA (United States); 21-23 Sep 1992)			
1	18:4213	*See* WINCO–11860			
3	18:2799	*See* WSRC-MS–92-261			
CONF-9209233–		(International k_0 users workshop; Gent (Belgium); 30 Sep - 2 oct 1992)			
1	18:4043	*See* UCRL-JC–110349			
CONF-9209236–		(13. air infiltration and ventilation conference: ventilation for energy efficiency and optimum indoor air quality; Nice (France); 15-18 Sep 1992)			
1	18:3529	*See* LBL–32639			
CONF-9209237–		(JOWOG 22D meeting; Aldermaston (United Kingdom); 29 Sep - 2 oct 1992)			
1	18:3056	*See* WSRC-MS–92-293			
CONF-9209238–		(American Welding Society (AWS) meeting; Cambridge, MA (United States); 21-23 Sep 1992)			
1	18:4451	*See* SAND–92-1938C			
CONF-9209239–		(Workshop on nuclear physics in the universe; Oak Ridge, TN (United States); 24-26 Sep 1992)			
1	18:4592	*See* LA-UR–92-3189			
CONF-9209240–		(Society of Engineering Science (SES) technical meeting; San Diego, CA (United States); 14-16 Sep 1992)			
1	18:4450	*See* SAND–92-0866C			
4	18:4466	*See* SAND–92-2083C			
CONF-9209242–		(1992 American Production of Inventory Control Society (APICS) remanufacturing seminar; Salt Lake City, UT (United States); 23-25 Sep 1992)			
1	18:3546	*See* PNL-SA–20301			
2	18:3548	*See* PNL-SA–20744			
3	18:3547	*See* PNL-SA–20309			
CONF-9209245–		(9. international conference on ion implantation technology; Gainesville, FL (United States); 21-24 Sep 1992)			
1	18:3644	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93001375	MF-404
CONF-9209254–		(12. world computer congress: From research to practice; Madrid (Spain); 7-11 Sep 1992)			
1	18:4831	*See* FAW-TR–92007			
CONF-9209270–		(2. workshop on tau lepton physics; Columbus, OH (United States); 8-11 Sep 1992)			
1	18:4575	*See* SLAC-PUB–5977			
CONF-920930–		(17. symposium on fusion technology; Rome (Italy); 14-18 Sep 1992)			
5	18:4748	*See* GA-A–21036			
7	18:4747	*See* GA-A–21016			
12	18:4753	*See* PNL-SA–20872			
CONF-920938–		(6. international symposium on solar thermal concentrating technologies; Mojacar (Spain); 25 Sep - 2 oct 1992)			
2	18:3816	*See* SAND–92-0263C			

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CONF-920944–		(6. annual New York State Institute on Superconductivity (NYSIS) conference on superconductivity and applications; Buffalo, NY (United States); 15-17 Sep 1992)			
4	18:3615	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93001716	MF-404
5	18:4688	*See* ANL/MSD/CP–77834			
CONF-920948–		(6. international conference on physics of highly charged ions; Manhattan, KS (United States); 28 Sep - 2 oct 1992)			
3	18:4659	*See* UCRL-JC–111468			
4	18:3966	*See* UCRL-JC–111447			
5	18:4661	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93001642	MF-413
CONF-920951–		(US Department of Energy contractors review meeting on gasification and gas stream cleanup systems; Morgantown, WV (United States); 15-17 Sep 1992)			
3	18:2962	*See* DOE/METC/C–93/7034			
4	18:2963	*See* DOE/METC/C–93/7035			
5	18:2501	*See* DOE/METC/C–93/7033			
6	18:4385	*See* DOE/MC/26018–93/C0111			
7	18:3671	*See* DOE/MC/26040–93/C0098			
CONF-920979–		(1. annual clean coal technology conference; Cleveland, OH (United States); 22-24 Sep 1992)			
2	18:2961	*See* DOE/MC/27363–93/C0076			
CONF-920988–		(19. annual National Energy and Environmental Quality Division of the American Society for Quality Control (ASQC)conference; Lake Buena Vista, FL (United States); 20-23 Sep 1992)			
1	18:2847	*See* WSRC-MS–92-315			
2	18:3665	*See* LA-UR–92-2914			
CONF-920995–		(Determination of partial structure factors of disordered matter by neutron and anomalous x-ray diffraction; Grenoble (France); 10-11 Sep 1992)			
1	18:3643	OSTI; NTIS; GPO Dep.	E 1.99:	DE93001650	MF-404
CONF-921004–		(International joint power generation conference; Atlanta, GA (United States); 18-22 Oct 1992)			
2	18:2960	OSTI; NTIS; GPO Dep.	E 1.99:	DE92041197	MF-105
CONF-921007–		(20. water reactor safety information meeting; Bethesda, MD (United States); 21-23 Oct 1992)			
2	18:3299	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93002426	
CONF-9210140–		(International fuels and lubricants meeting and exposition; San Francisco, CA (United States); 19-22 Oct 1992)			
1	18:3558	*See* ANL/CP–77453			
CONF-9210158–		(Infotech '92; Oak Ridge, TN (United States); 21-23 Oct 1992)			
1	18:4835	*See* WHC-SA–1480			
CONF-9210171–		(Eastern regional groundwater issues conference; Boston, MA (United States); 13 Oct 1992)			
1	18:4215	*See* WSRC-MS–92-214			
CONF-9210174–		(1992 Korean automated control conference (KACC); Seoul (Korea, Republic of); 19-21 Oct 1992)			
1	18:3906	OSTI; NTIS; GPO Dep.	E 1.99:	DE93000428	MF-906
CONF-9210175–		(24. international Society for the Advancement of Material and Process Engineering (SAMPE) technical conference; Toronto (Canada); 20-22 Oct 1992)			
1	18:3611	*See* ANL/CP–76346			
CONF-9210176–		(63. shock and vibration symposium; Las Cruces, NM (United States); 27 Oct 1992)			
3	18:3926	*See* SAND–92-1201C			
CONF-9210180–		(Solution Mining Research Institute (SMRI) fall meeting; Houston, TX (United States); 19-21 Oct 1992)			
1	18:2622	*See* SAND–92-2042C			

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CONF-9210181–		(43. Aeroballistic Range Association (ARA) meeting; Columbus, OH (United States); 2 Oct 1992)			
1	18:3951	*See* LA-UR–92-3227			
CONF-9210182–		(Advanced workshop on whiskers and particles in composite materials technology; Trieste (Italy); 5-9 Oct 1992)			
1	18:3616	OSTI; NTIS; GPO Dep.	E 1.99:	DE93001372	MF-404
CONF-9210183–		(Northeast Sustainable Energy Association meeting; Boston, MA (United States); 9-10 Oct 1992)			
Vol.1	18:3554	OSTI; NTIS; GPO Dep.	E 1.99:	DE93001501	MF-333
Vol.2	18:3521	OSTI; NTIS; GPO Dep.	E 1.99:	DE93001500	MF-333
CONF-9210184–		(2. Japan Atomic Energy Research Institute (JAERI) symposium on high temperature gas-cooled reactor (HTGR) technologies; Ibaraki-ken (Japan); 21-23 Oct 1992)			
1	18:3018	*See* GA-A–21079			
CONF-9210186–		(18. annual meeting of the Spanish Nuclear Society (SNS); Puerto de Santa Maria (Spain); 28-30 Oct 1992)			
1	18:3298	*See* BNL-NUREG–47880			
CONF-9210191–		(Southeastern simulation conference; Pensacola, FL (United States); 22-23 Oct 1992)			
1	18:3069	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93001639	MF-406
CONF-9210192–		(Workshop on applications of high resolution gamma spectroscopy in studies of atomic collisions and nuclear lifetimes; Grenoble (France); 5-7 Oct 1992)			
1	18:4596	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93001709	MF-413
CONF-9210193–		(5. international symposium on knowledge engineering; Seville (Spain); 5-9 Oct 1992)			
1	18:3070	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93001708	MF-530
CONF-9210194–		(International symposium on environmental contamination; Budapest (Hungary); 12-16 Oct 1992)			
2	18:4020	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93001636	MF-406
CONF-9210205–		(2. ballistics symposium on classified topics; Baltimore, MD (United States); 26-29 Oct 1992)			
1	18:4061	*See* SAND–92-0667C			
CONF-9210217–		(International congress on application of laser and electro-optics; Orlando, FL (United States); 25-29 Oct 1992)			
1	18:3954	*See* ANL/EP/CP–76192			
CONF-921029–		(Annual Department of Energy model conference on waste management and environmental restoration; Oak Ridge, TN (United States); 19-22 Oct 1992)			
7	18:2827	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93000438	MF-902
9	18:2828	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93001640	MF-402
CONF-921036–		(182. meeting of the Electrochemical Society; Toronto (Canada); 11-16 Oct 1992)			
9	18:3822	*See* LBL–32417			
CONF-921037–		(9. annual international Pittsburgh coal conference; Pittsburgh, PA (United States); 12-16 Oct 1992)			
6	18:2575	*See* DOE/MC/24132–92/C0079			
CONF-921046–		(Symposium on nuclear data evaluation methodology; Upton, NY (United States); 12-16 Oct 1992)			
2	18:3040	*See* ANL/RA/CP–77609			
3	18:4019	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93001643	MF-413
4	18:4608	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93001635	MF-413
5	18:4637	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93001632	MF-522
CONF-921049–		(Windpower '92; Seattle, WA (United States); 19-23 Oct 1992)			
2	18:2954	*See* NREL/TP–442-5159			
3	18:2955	*See* SAND–92-1061C			
CONF-921066–		(Oceans '92; Newport, RI (United States); 26-29 Oct 1992)			
1	18:4223	*See* BNL–47921			

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CONF-921102–		(Joint American Nuclear Society (ANS)/European Nuclear Society (ENS) international meeting on fifty years of controlled nuclear chain reaction: past, present, and future; Chicago, IL (United States); 15-20 Nov 1992)			
	18:4645	*See* ORNL/RSIC–55			
21	18:3041	*See* BNL-NUREG–47882			
23	18:3302	*See* EGG-M–92391			
24	18:3303	*See* EGG-M–92423			
25	18:2983	*See* BNL-NUREG–47960			
26-Rev.1	18:2798	*See* WSRC-MS–92-203-Rev.1			
28	18:3445	*See* WSRC-MS–92-200			
CONF-921104–		(American Institute of Chemical Engineers annual meeting; Miami, FL (United States); 1-6 Nov 1992)			
6	18:3516	*See* DOE/METC/C–93/7031			
CONF-921109–		(Fall meeting of the Metallurgical Society and American Institute Metallurgical and Petroleum Engineers; Chicago, IL (United States); 1-5 Nov 1992)			
2	18:3605	*See* SAND–92-1958C			
CONF-921110–		(Winter annual meeting of the American Society of Mechanical Engineers (ASME); Anaheim, CA (United States); 8-13 Nov 1992)			
30	18:3776	OSTI; NTIS; GPO Dep.	E 1.99:	DE93002421	MF-310
CONF-9211107–		(Discovery program workshop; San Jaua Capistrano, CA (United States); 16 Nov 1992)			
1	18:4460	*See* LA-UR–92-3049			
CONF-9211108–		(7. European conference on information systems security, audit, and control; Brussels (Belgium); 16-18 Nov 1992)			
1	18:4811	*See* LA-UR–92-3214			
CONF-9211110–		(Microstructure and mechanical properties of aging materials; Detroit, MI (United States); 2-5 Nov 1992)			
1	18:3572	OSTI; NTIS; GPO Dep.	E 1.99:	DE93001373	MF-524
CONF-9211113–		(International conference on computerization of welding; Orlando, FL (United States); 3-6 Nov 1992)			
1	18:3910	*See* EGG-M–92101			
CONF-921116–		(12. international conference on the application of accelerators in research and industry; Denton, TX (United States); 2-5 Nov 1992)			
4	18:4662	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93002338	MF-411
5	18:4739	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93002341	MF-420
CONF-921122–		(Meeting of the Division of Particles and Fields of the American Physics Society; Batavia, IL (United States); 10-14 Nov 1992)			
1	18:4560	*See* SLAC-PUB–5974			
2	18:4561	*See* SLAC-PUB–5976			
CONF-921181–		(ISRAM '92: 4th international symposium on robotics and manufacturing; Sante Fe, NM (United States); 11-13 Nov 1992)			
4	18:3927	*See* SAND–92-1722C			
CONF-921201–		(Conference on magnetism and magnetic materials; Houston, TX (United States); 1-4 Dec 1992)			
1	18:3599	*See* LA-UR–92-2701			
3	18:3573	OSTI; NTIS; GPO Dep.	E 1.99:	DE93001712	MF-404
4	18:4677	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93001628	MF-413
5	18:4678	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93001634	MF-410
6	18:4679	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93001718	MF-411
CONF-921203–		(Thermal performance of the exterior envelopes of buildings; Clearwater, FL (United States); 7-10 Dec 1992)			
5	18:3523	OSTI; NTIS; GPO Dep.	E 1.99:	DE92041251	MF-350
CONF-921206–		(Material Research Society (MRS) symposium; Boston, MA (United States); 2-6 Dec 1992)			
1	18:3661	*See* SAND–92-0175C			
2	18:3641	*See* SAND–91-2901C			
3	18:3658	*See* LA-UR–92-684			

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CONF-921226–		(1992 Institute of Electrical and Electronic Engineers (IEEE) semiconductor interface specialists conference; San Diego, CA (United States); 9-13 Dec 1992)			
4	18:3965	*See* SAND–92-1919C			
CONF-921228–		(31. Institute of Electrical and Electronics Engineers (IEEE) conference on decision and control; Tuscon, AZ (United States); 16-18 Dec 1992)			
1	18:3907	OSTI; NTIS; GPO Dep.	E 1.99:	DE93001647	
2	18:3929	*See* SAND–92-2214C			
CONF-930103–		(10. symposium on space nuclear power and propulsion; Albuquerque, NM (United States); 10-14 Jan 1993)			
1	18:3030	*See* LA-UR–92-1624			
2	18:2858	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE92017126	MF-504
3	18:3025	OSTI; NTIS; GPO Dep.	E 1.99:	DE92016788	MF-528
4	18:3610	*See* Y/DV–1153/R1			
5	18:3655	*See* IS-M–720			
6	18:3032	*See* SAND–92-1207C			
7	18:3294	*See* Y/DZ–919			
8	18:3081	*See* SAND–92-1744C			
9	18:3293	*See* WHC-SA–1536			
10	18:3510	*See* WHC-SA–1594			
12	18:3033	*See* SAND–92-1407C			
CONF-930108–		(31. American Institute of Astronautics and Aeronautics (AIAA) aerospace sciences meeting; Reno, NV (United States); 11-14 Jan 1993)			
1	18:3029	*See* LA-UR–92-848			
CONF-930113–		(Object oriented simulation conference; San Diego, CA (United States); 17-20 Jan 1993)			
1	18:3977	*See* SSCL-Preprint–122			
CONF-930116–		(Probabilistic safety assessment international topical meeting; Clearwater Beach, FL (United States); 27-29 Jan 1993)			
1	18:3446	*See* WSRC-MS–92-227			
2	18:3297	*See* BNL-NUREG–47538			
3	18:3295	*See* BNL-NUREG–47531			
4	18:3296	*See* BNL-NUREG–47537			
5	18:3444	*See* SAND–92-1261C			
6	18:3443	*See* SAND–92-0978C			
7	18:4816	*See* SAND–92-1063C			
CONF-930117–		(26. Hawaiian international conference on system science: biotechnology computing track; Kauai, HI (United States); 5-8 Jan 1993)			
1	18:4276	*See* LA-UR–92-1909			
2	18:4278	*See* LA-UR–92-1850			
3	18:4798	*See* FNAL/C–92/163			
4	18:4826	*See* UCRL-JC–111428			
CONF-930118–		(Winter meeting of the American Society of Heating, Refrigeration and Air Conditioning Engineers; Chicago, IL (United States); 23-27 Jan 1993)			
1	18:3524	OSTI; NTIS; GPO Dep.	E 1.99:	DE92017132	MF-350
CONF-930120–		(72. Transportation Research Board meeting; Washington, DC (United States); 10-14 Jan 1993)			
1	18:3532	OSTI; NTIS; GPO Dep.	E 1.99:	DE92018494	MF-335
2	18:3533	OSTI; NTIS; GPO Dep.	E 1.99:	DE92040025	MF-335
CONF-930129–		(Working conference on architecture and compilation techniques for fine and medium grain parallelism; Orlando, FL (United States); 20-22 Jan 1993)			
1	18:4808	*See* LA-UR–92-2511			
CONF-930130–		(26. Health Physics Society midyear topical meeting on environmental health physics; Coeur d'Alene, ID (United States); 24-28 Jan 1993)			
1	18:4372	*See* WSRC-MS–92-349			

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CONF-930133–		(73. American Meteorological Society (AMS) annual meeting; Anaheim, CA (United States); 17-22 Jan 1993)			
2	18:4113	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE92041261	MF-402
3	18:4147	*See* UCRL-JC–111848			
CONF-930142–		(4. American Meteorological Society (AMS) symposium on global change studies; Anaheim, CA (United States); 14-19 Jan 1993)			
1	18:4137	*See* LA-UR–92-3030			
CRES-TR–					
8912/04.	18:4204	*See* NSS-R–213			
CTA-IEAV-NT–					
005/92	18:3042	OSTI; NTIS (US Sales Only); INIS		DE93607640	
07/87	18:4829	OSTI; NTIS (US Sales Only); INIS		DE93608116	
CTA-IEAV-RI–					
006/92	18:3043	OSTI; NTIS (US Sales Only); INIS		DE93607700	
007/83	18:4582	OSTI; NTIS (US Sales Only); INIS		DE93608409	
007/89	18:3026	OSTI; NTIS (US Sales Only); INIS		DE93607823	
010/87	18:4778	OSTI; NTIS (US Sales Only); INIS		DE93608122	
04/86	18:3021	OSTI; NTIS (US Sales Only); INIS		DE93607797	
04/87	18:4776	OSTI; NTIS (US Sales Only); INIS		DE93608123	
08/87	18:4777	OSTI; NTIS (US Sales Only); INIS		DE93608124	
CTA-IEAV-RP–					
010/85	18:2994	OSTI; NTIS (US Sales Only); INIS		DE93607752	
CTH-IEFT-PP–					
1992-14	18:4704	OSTI; NTIS; INIS		DE93608546	
1992-15	18:4705	OSTI; NTIS; INIS		DE93608547	
1992-16	18:4706	OSTI; NTIS; INIS		DE93608569	
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115	18:4435	*See* DOE/ER/14079–21			
DESY–					
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92-072	18:4483	OSTI; NTIS (US Sales Only); INIS		DE93728754	
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91-01	18:4821	*See* UCRL-CR–111574			
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DOE/ER/14017–4	18:3618	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93002707	MF-411
DOE/ER/14079–21	18:4435	OSTI; NTIS; GPO Dep.	E 1.99:	DE93004454	MF-403
DOE/ER/14090–3	18:3909	OSTI; NTIS; GPO Dep.	E 1.99:	DE93001838	MF-406
DOE/ER/14135–1	18:3574	OSTI; NTIS; GPO Dep.	E 1.99:	DE93004288	MF-406
DOE/ER/14136–2	18:3938	OSTI; NTIS; GPO Dep.	E 1.99:	DE93003145	MF-406
DOE/ER/14145–T2	18:4670	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93002842	MF-411
DOE/ER/14190–1	18:3791	OSTI; NTIS; GPO Dep.	E 1.99:	DE93004647	MF-401
DOE/ER/14226–1	18:3792	OSTI; NTIS; GPO Dep.	E 1.99:	DE93003721	MF-401
DOE/ER/20053–1	18:2904	OSTI; NTIS; GPO Dep.	E 1.99:	DE93002236	MF-401
DOE/ER/25052–T1	18:4781	OSTI; NTIS; GPO Dep.	E 1.99:	DE93002096	MF-405
DOE/ER/25086–T1	18:4639	OSTI; NTIS; GPO Dep.	E 1.99:	DE93003881	MF-405
DOE/ER/25107–1	18:4782	OSTI; NTIS; GPO Dep.	E 1.99:	DE93000781	MF-405
DOE/ER/25120–1	18:3939	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93002420	MF-410
DOE/ER/30196–1	18:4178	OSTI; NTIS; GPO Dep.	E 1.99:	DE93001862	MF-402
2	18:4235	OSTI; NTIS; GPO Dep.	E 1.99:	DE93000543	MF-402
DOE/ER/40077–10	18:4689	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93005009	MF-414
DOE/ER/40150–200	18:4566	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93000828	MF-414
DOE/ER/40200–298	18:4468	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93001797	MF-414
DOE/ER/40246–7	18:4609	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93003655	MF-413
DOE/ER/40310–T2	18:4023	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93004366	MF-413
DOE/ER/40323–T6	18:4024	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93004133	MF-414
DOE/ER/40330–64	18:4583	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93002795	MF-413
DOE/ER/40343–6	18:4610	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93004375	MF-413
DOE/ER/40365–6	18:4578	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93004373	MF-413
DOE/ER/40390–5	18:4543	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93001800	MF-413
DOE/ER/40405–5	18:4611	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93003661	MF-413

Report Number	Abstract Number	Source of Availability	GPO Dep.	Order Number	Distribution Category
DOE/ER/40412–T1	18:4544	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93002094	MF-414
DOE/ER/40418–5	18:4584	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93002791	MF-413
DOE/ER/40454–T2	18:4545	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93004368	MF-413
DOE/ER/40516–2	18:4469	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93002337	MF-414
DOE/ER/40542–73	18:4487	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93003687	MF-414
DOE/ER/40544–1	18:4025	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93002733	MF-414
DOE/ER/40615–2	18:4026	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93003884	MF-414
DOE/ER/40651–2	18:4470	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93003147	MF-414
3	18:4546	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93003652	MF-414
DOE/ER/40653–1	18:4027	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93003900	MF-414
DOE/ER/40654–2	18:4471	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93002091	MF-414
DOE/ER/40671–1	18:4472	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93001793	MF-414
DOE/ER/40676–2	18:4473	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE92041135	MF-414
DOE/ER/40682–3	18:4567	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93002416	MF-414
5	18:4547	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93002414	MF-414
10	18:4488	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93002643	MF-414
15	18:4512	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93002647	MF-414
16	18:4513	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93002648	MF-414
17	18:4474	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93002411	MF-414
19	18:4489	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93002650	MF-414
20	18:4455	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93002651	MF-414
DOE/ER/40684–1	18:4475	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93003154	MF-414
DOE/ER/40689–T1	18:4476	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93002639	MF-410
DOE/ER/40690–1	18:4477	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93003153	MF-414
DOE/ER/40715–1	18:4478	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93002418	MF-414
DOE/ER/40716–1	18:4490	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93002163	MF-414
DOE/ER/45056–10	18:3825	OSTI; NTIS; GPO Dep.	E 1.99:	DE93002133	MF-404
DOE/ER/45097–9	18:3619	OSTI; NTIS; GPO Dep.	E 1.99:	DE93002652	MF-404
DOE/ER/45113–T4	18:3620	OSTI; NTIS; GPO Dep.	E 1.99:	DE93002786	MF-404
DOE/ER/45120–T1	18:3575	OSTI; NTIS; GPO Dep.	E 1.99:	DE93002766	MF-401
T2	18:3793	OSTI; NTIS; GPO Dep.	E 1.99:	DE93002765	MF-401
T3	18:3794	OSTI; NTIS; GPO Dep.	E 1.99:	DE93002764	MF-401
DOE/ER/45130–7	18:3576	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93002230	MF-411
DOE/ER/45204–T5	18:3646	OSTI; NTIS; GPO Dep.	E 1.99:	DE93002767	MF-404
DOE/ER/45208–8	18:3647	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93002788	MF-411
DOE/ER/45214–T5	18:3577	OSTI; NTIS; GPO Dep.	E 1.99:	DE93002136	MF-404
DOE/ER/45239–8	18:3578	OSTI; NTIS; GPO Dep.	E 1.99:	DE93004371	MF-404
DOE/ER/45279–1	18:3621	OSTI; NTIS; GPO Dep.	E 1.99:	DE93002679	MF-404
DOE/ER/45281–7	18:3579	OSTI; NTIS; GPO Dep.	E 1.99:	DE93004951	MF-404
DOE/ER/45283–11	18:3622	OSTI; NTIS; GPO Dep.	E 1.99:	DE93001953	MF-404; MF-406

Report Number	Abstract Number	Source of Availability	GPO Dep.	Order Number	Distribution Category
DOE/ER/45294–T4	18:3648	OSTI; NTIS; GPO Dep.	E 1.99:	DE93002466	MF-404
DOE/ER/45295–T2	18:3580	OSTI; NTIS; GPO Dep.	E 1.99:	DE93002769	MF-404
DOE/ER/45337–5	18:3623	OSTI; NTIS; GPO Dep.	E 1.99:	DE93003654	MF-404
DOE/ER/45347–32	18:4690	OSTI; NTIS; GPO Dep.	E 1.99:	DE93002839	MF-410
51	18:3649	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93001954	MF-410; MF-404
DOE/ER/45439–132	18:3565	OSTI; NTIS; GPO Dep.	E 1.99:	DE93002655	MF-404
DOE/ER/45461–1	18:3821	OSTI; NTIS; GPO Dep.	E 1.99:	DE93002747	MF-404
DOE/ER/51069–T2	18:4740	OSTI; NTIS; GPO Dep.	E 1.99:	DE93004139	MF-421
T5	18:4741	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93004142	MF-421
T6	18:4742	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93004143	MF-421
DOE/ER/52124–T2	18:4743	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93003266	MF-424
DOE/ER/52158–3	18:4744	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93004639	MF-424
DOE/ER/53145–T1	18:4707	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93004136	MF-420
DOE/ER/53188–9	18:4663	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93002654	MF-426
DOE/ER/53194–5	18:4708	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93003241	MF-410
DOE/ER/53212–198	18:4709	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93002775	MF-427
DOE/ER/53225–T6	18:4710	OSTI; NTIS; GPO Dep.	E 1.99:	DE93002531	MF-420
DOE/ER/53236–T3	18:4711	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93003774	MF-421
DOE/ER/54104–1	18:4664	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93002129	MF-411
DOE/ER/54115–T2	18:3624	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93003268	MF-404
DOE/ER/60397–5	18:4116	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93003149	MF-402
DOE/ER/60400–6	18:4279	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93003146	MF-401
DOE/ER/60417–006	18:4323	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93003659	MF-408
DOE/ER/60455–T4	18:4324	OSTI; NTIS; GPO Dep.	E 1.99:	DE93003715	MF-408
DOE/ER/60464–6	18:4325	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93001832	MF-408
DOE/ER/60485–4	18:4117	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93003150	MF-402
DOE/ER/60533–5	18:4326	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93003658	MF-408
DOE/ER/60639–5	18:4280	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93004637	MF-408
DOE/ER/60655–T1	18:4384	OSTI; NTIS; GPO Dep.	E 1.99:	DE93003882	MF-408
DOE/ER/60668–5	18:4327	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93003718	MF-407
DOE/ER/60743–3	18:4179	OSTI; NTIS; GPO Dep.	E 1.99:	DE93002801	MF-402
DOE/ER/60775–T1	18:4180	OSTI; NTIS; GPO Dep.	E 1.99:	DE93004643	MF-408
DOE/ER/60791–1	18:3940	OSTI; NTIS; GPO Dep.	E 1.99:	DE93003086	MF-406
DOE/ER/60988–T1	18:4181	OSTI; NTIS; GPO Dep.	E 1.99:	DE93003594	MF-402
DOE/ER/61019–3	18:4236	OSTI; NTIS; GPO Dep.	E 1.99:	DE93004601	MF-402
DOE/ER/61062–T1	18:4118	OSTI; NTIS; GPO Dep.	E 1.99:	DE93002638	MF-402

Report Number	Abstract Number	Source of Availability	GPO Dep.	Order Number	Distribution Category
DOE/ER/61085– 2	18:4328	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93003341	MF-408
DOE/ER/61091– T1	18:4281	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93004636	MF-407
DOE/ER/61125– 2	18:4275	OSTI; NTIS; GPO Dep.	E 1.99:	DE93004145	MF-408
DOE/ER/61364– 1	18:4119	OSTI; NTIS; GPO Dep.	E 1.99:	DE93003245	MF-402
DOE/ER/61365– 1	18:4120	OSTI; NTIS; GPO Dep.	E 1.99:	DE93004648	MF-406
DOE/ER/69017– 4	18:4121	OSTI; NTIS; GPO Dep.	E 1.99:	DE93002837	MF-402
DOE/ER/75609– T1	18:4760	OSTI; NTIS; GPO Dep.	E 1.99:	DE93004364	MF-400
DOE/ER/75637– 1	18:4182	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93002419	MF-402
DOE/ER/75682– 1-PT.1	18:3481	OSTI; NTIS; GPO Dep.	E 1.99:	DE93001485	MF-400
1-Pt.2	18:3459	OSTI; NTIS; GPO Dep.	E 1.99:	DE93001486	MF-400
1-Pt.3	18:3460	OSTI; NTIS; GPO Dep.	E 1.99:	DE93001487	MF-400
1-Pt.5	18:3482	OSTI; NTIS; GPO Dep.	E 1.99:	DE93001489	MF-400
DOE/ET/17089– 3120	18:3511	OSTI; NTIS; GPO Dep.	E 1.99:	DE92012462	PC-110
DOE/EW/40017– T3	18:2829	OSTI; NTIS; GPO Dep.	E 1.99:	DE93002311	MF-902
DOE/FE– 0268P	18:2621	OSTI; NTIS; GPO Dep.	E 1.99:	DE93002235	MF-126
DOE/FE/60848– T1	18:2499	OSTI; NTIS; GPO Dep.	E 1.99:	DE93002850	MF-109
DOE/ID– 10385	18:3557	OSTI; NTIS; GPO Dep.	E 1.99:	DE93001943	MF-333
10387	18:2698	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93001922	MF-902
DOE/ID/12839– 9	18:2599	OSTI; NTIS; GPO Dep.	E 1.99:	DE93003304	MF-122
DOE/ID/12850– 5	18:2945	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93002272	MF-256
6	18:2946	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93002273	MF-256
DOE/ID/13042– T4	18:4237	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93003254	MF-902
DOE/ID/13062– T1	18:3670	OSTI; NTIS; GPO Dep.	E 1.99:	DE93003285	PC-310
DOE/ID/13074– T5	18:3555	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93003161	MF-333
DOE/IG– 0315	18:2653	OSTI (Free of Charge); INIS		TI93002861	PC-960
DOE/MC/10637– 3134	18:2968	OSTI; NTIS; GPO Dep.	E 1.99:	DE93000218	MF-105
DOE/MC/24012– 3100	18:2574	OSTI; NTIS; GPO Dep.	E 1.99:	DE93003363	MF-113
DOE/MC/24132– 92/C0079	18:2575	OSTI; NTIS; GPO Dep.	E 1.99:	DE93002152	MF-103
DOE/MC/24207– 2997	18:2576	OSTI; NTIS; GPO Dep.	E 1.99:	DE91002078	MF-103
3007	18:4783	OSTI; NTIS; GPO Dep.	E 1.99:	DE91002087	MF-103
DOE/MC/24221– 3130	18:3512	OSTI; NTIS; GPO Dep.	E 1.99:	DE93000215	MF-110
3143	18:3513	OSTI; NTIS; GPO Dep.	E 1.99:	DE93003358	MF-110
DOE/MC/25020– 3128	18:2500	OSTI; NTIS; GPO Dep.	E 1.99:	DE93000213	MF-109
DOE/MC/25027– 3112	18:2605	OSTI; NTIS; GPO Dep.	E 1.99:	DE92012455	PC-124
DOE/MC/25115– 3113	18:2624	OSTI; NTIS; GPO Dep.	E 1.99:	DE92012456	PC-122
DOE/MC/26018– 93/C0111	18:4385	OSTI; NTIS; GPO Dep.	E 1.99:	DE93002611	MF-107; MF-109
DOE/MC/25040– 93/C0098	18:3671	OSTI; NTIS; GPO Dep.	E 1.99:	DE93002606	MF-106; MF-109
DOE/MC/27363– 93/C0076	18:2961	OSTI; NTIS; GPO Dep.	E 1.99:	DE93001482	MF-109

Report Number	Abstract Number	Source of Availability	GPO Dep.	Order Number	Distribution Category
DOE/MC/27393–					
3125	18:3514	OSTI; NTIS; GPO Dep.	E 1.99:	DE93000205	PC-110
DOE/METC/C–					
92/7026	18:3515	OSTI; NTIS; GPO Dep.	E 1.99:	DE93001377	MF-110
93/7031	18:3516	OSTI; NTIS; GPO Dep.	E 1.99:	DE93001381	MF-110
93/7032	18:2577	OSTI; NTIS; GPO Dep.	E 1.99:	DE93001378	MF-103
93/7033	18:2501	OSTI; NTIS; GPO Dep.	E 1.99:	DE93001384	MF-106
93/7034	18:2962	OSTI; NTIS; GPO Dep.	E 1.99:	DE93001383	MF-106
93/7035	18:2963	OSTI; NTIS; GPO Dep.	E 1.99:	DE93001382	MF-106
DOE/NP/00119–					
2-Vol.1	18:4765	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93004124	MF-1000
DOE/NV/10594–					
T2	18:4122	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93000909	MF-700
DOE/NV/10630–					
23	18:4183	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93001390	MF-721
37	18:4123	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93003155	MF-702
38	18:2733	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93003305	MF-721
42	18:4124	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93004380	MF-702
DOE/NV/10845–					
15	18:2813	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93003157	MF-703
DOE/OR–					
1070-D2	18:2830	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93001421	MF-902
DOE/OR/00033–					
T499	18:2734	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93001698	MF-800
DOE/OR/21389–					
37	18:2861	OSTI; NTIS; GPO Dep.	E 1.99:	DE93002790	MF-247
38	18:2907	OSTI; OSTI; NTIS; GPO Dep.	E 1.99:	DE93002800	MF-247
DOE/OR/21548–					
228-Rev.1	18:2831	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93001564	MF-511
DOE/OR/21949–					
340	18:2832	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93001266	MF-902
342	18:2833	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93001268	MF-902
343	18:2834	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93001262	MF-902
344	18:2835	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93001263	MF-902
345	18:2836	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93001264	MF-902
346	18:2837	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93001265	MF-902
DOE/PC–					
93000364	18:2494	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93000364	MF-101
DOE/PC/70023–					
T10	18:2508	OSTI; NTIS; GPO Dep.	E 1.99:	DE93003299	MF-108
T11	18:2509	OSTI; NTIS; GPO Dep.	E 1.99:	DE93003300	MF-108
T12	18:2510	OSTI; NTIS; GPO Dep.	E 1.99:	DE93003301	MF-108
T3	18:2502	OSTI; NTIS; GPO Dep.	E 1.99:	DE93003291	MF-108
T4	18:2503	OSTI; NTIS; GPO Dep.	E 1.99:	DE93003293	MF-108
T6	18:2504	OSTI; NTIS; GPO Dep.	E 1.99:	DE93003295	MF-108
T7	18:2505	OSTI; NTIS; GPO Dep.	E 1.99:	DE93003296	MF-108
T8	18:2506	OSTI; NTIS; GPO Dep.	E 1.99:	DE93003297	MF-108
T9	18:2507	OSTI; NTIS; GPO Dep.	E 1.99:	DE93003298	MF-108
DOE/PC/79660–					
T5	18:2578	OSTI; NTIS; GPO Dep.	E 1.99:	DE93003880	MF-104
T6	18:2579	OSTI; NTIS; GPO Dep.	E 1.99:	DE93002681	MF-104
T7	18:2580	OSTI; NTIS; GPO Dep.	E 1.99:	DE93004031	MF-104
T8	18:2581	OSTI; NTIS; GPO Dep.	E 1.99:	DE93004032	MF-104
T9	18:2582	OSTI; NTIS; GPO Dep.	E 1.99:	DE93004033	MF-104
DOE/PC/79796–					
T28	18:2969	OSTI; NTIS; GPO Dep.	E 1.99:	DE92041299	MF-105
DOE/PC/79887–					
T18	18:2495	OSTI; NTIS; GPO Dep.	E 1.99:	DE93003192	MF-105
DOE/PC/79903–					
T14	18:2555	OSTI; NTIS; GPO Dep.	E 1.99:	DE92041182	MF-105
T16	18:2556	OSTI; NTIS; GPO Dep.	E 1.99:	DE92041305	MF-105
DOE/PC/88818–					
15	18:2511	OSTI; NTIS; GPO Dep.	E 1.99:	DE93004924	MF-108
DOE/PC/88914–					
T5	18:2970	OSTI; NTIS; GPO Dep.	E 1.99:	DE93001342	MF-105
T6	18:2971	OSTI; NTIS; GPO Dep.	E 1.99:	DE93002575	MF-105
DOE/PC/88928–					
T17	18:3509	OSTI; NTIS; GPO Dep.	E 1.99:	DE93001721	PC-112
DOE/PC/88933–					
3	18:2512	OSTI; NTIS; GPO Dep.	E 1.99:	DE93003538	MF-113

Report Number	Abstract Number	Source of Availability	GPO Dep.	Order Number	Distribution Category
T1	18:2513	OSTI; NTIS; GPO Dep.	E 1.99:	DE93003539	MF-113
DOE/PC/88943–					
T4	18:2972	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93002491	MF-113
T5	18:2973	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93002492	MF-113
DOE/PC/89653–					
T5	18:2974	OSTI; NTIS; GPO Dep.	E 1.99:	DE93004361	MF-105
DOE/PC/89658–					
T3	18:2514	OSTI; NTIS; GPO Dep.	E 1.99:	DE93004944	MF-102
T4	18:2515	OSTI; NTIS; GPO Dep.	E 1.99:	DE93004943	MF-102
T5	18:2516	OSTI; NTIS; GPO Dep.	E 1.99:	DE93004942	MF-102
DOE/PC/89757–					
8	18:2557	OSTI; NTIS; GPO Dep.	E 1.99:	DE92040016	MF-102
DOE/PC/89760–					
T11	18:2517	OSTI; NTIS; GPO Dep.	E 1.99:	DE93001269	MF-109
DOE/PC/89764–					
T9	18:2558	OSTI; NTIS; GPO Dep.	E 1.99:	DE92041296	MF-113
DOE/PC/89770–					
T13	18:2518	OSTI; NTIS; GPO Dep.	E 1.99:	DE93002941	MF-102
DOE/PC/89774–					
T5	18:2583	OSTI; NTIS; GPO Dep.	E 1.99:	DE92041297	MF-104
DOE/PC/89776–					
T10	18:2584	OSTI; NTIS; GPO Dep.	E 1.99:	DE93004940	MF-104
DOE/PC/89785–					
T1	18:2559	OSTI; NTIS; GPO Dep.	E 1.99:	DE92041298	MF-113
T2	18:2560	OSTI; NTIS; GPO Dep.	E 1.99:	DE92041288	MF-113
DOE/PC/89793–					
T5	18:2519	OSTI; NTIS; GPO Dep.	E 1.99:	DE93003853	MF-113
DOE/PC/89883–					
50	18:2544	OSTI; NTIS; GPO Dep.	E 1.99:	DE93000646	MF-108
51	18:2545	OSTI; NTIS; GPO Dep.	E 1.99:	DE93000465	PC-108
DOE/PC/90027–					
T3	18:2546	OSTI; NTIS; GPO Dep.	E 1.99:	DE93000910	MF-108
DOE/PC/90275–					
T21	18:2964	OSTI; NTIS; GPO Dep.	E 1.99:	DE93000879	MF-104
DOE/PC/90292–					
T7	18:2975	OSTI; NTIS; GPO Dep.	E 1.99:	DE92041246	MF-105
DOE/PC/90311–					
8	18:2496	OSTI; NTIS; GPO Dep.	E 1.99:	DE93000920	MF-117
DOE/PC/90756–					
T10	18:2589	OSTI; NTIS; GPO Dep.	E 1.99:	DE93003897	MF-104
T11	18:2590	OSTI; NTIS; GPO Dep.	E 1.99:	DE93003898	MF-104
T12	18:2591	OSTI; NTIS; GPO Dep.	E 1.99:	DE93003899	MF-104
T5	18:2585	OSTI; NTIS; GPO Dep.	E 1.99:	DE93003892	MF-104
T6	18:2586	OSTI; NTIS; GPO Dep.	E 1.99:	DE93003893	MF-104
T7	18:2587	OSTI; NTIS; GPO Dep.	E 1.99:	DE93003894	MF-104
T8	18:2588	OSTI; NTIS; GPO Dep.	E 1.99:	DE93003895	MF-104
DOE/PC/91052–					
3	18:2547	OSTI; NTIS; GPO Dep.	E 1.99:	DE93004921	MF-108
DOE/PC/91281–					
T4	18:2548	OSTI; NTIS; GPO Dep.	E 1.99:	DE92041290	MF-108
DOE/PC/91287–					
4	18:3795	OSTI; NTIS; GPO Dep.	E 1.99:	DE93004922	MF-102
DOE/PC/91288–					
T4	18:3672	OSTI; NTIS; GPO Dep.	E 1.99:	DE93000733	MF-109
DOE/PC/91307–					
T5	18:2592	OSTI; NTIS; GPO Dep.	E 1.99:	DE93004926	MF-113
DOE/PC/91308–					
4	18:2593	OSTI; NTIS; GPO Dep.	E 1.99:	DE93003095	MF-104
DOE/PC/91310–					
4	18:2566	OSTI; NTIS; GPO Dep.	E 1.99:	DE93004923	MF-113
DOE/PC/91334–					
T89	18:2549	OSTI; NTIS; GPO Dep.	E 1.99:	DE93000957	MF-113
T90	18:2550	OSTI; NTIS; GPO Dep.	E 1.99:	DE93000956	MF-102
T91	18:2551	OSTI; NTIS; GPO Dep.	E 1.99:	DE93000955	MF-105
T93	18:2497	OSTI; NTIS; GPO Dep.	E 1.99:	DE93000950	MF-102
T94	18:2567	OSTI; NTIS; GPO Dep.	E 1.99:	DE93000949	MF-113
DOE/PN/38014–					
T1	18:4238	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93000382	MF-502
DOE/RA/50219–					
T23	18:4429	OSTI; NTIS; GPO Dep.	E 1.99:	DE93002641	MF-220
T25	18:4430	OSTI; NTIS; GPO Dep.	E 1.99:	DE93002762	MF-220

Report Number	Abstract Number	Source of Availability	GPO Dep.	Order Number	Distribution Category
T26	18:4431	OSTI; NTIS; GPO Dep.	E 1.99:	DE93002763	MF-220
DOE/RL–					
89-09	18:2838	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93002054	MF-630
90-03-Rev.1	18:2735	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93002179	MF-630; MF-721
90-04-Rev.1	18:2736	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93002176	MF-902
90-20	18:2839	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93002197	MF-902
91-35	18:2737	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93002239	MF-702
92-30	18:2814	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93001678	MF-603
92-37	18:4101	OSTI; NTIS; GPO Dep.	E 1.99:	DE93001450	MF-502
92-62	18:2815	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93002051	MF-902
DOE/RW–					
0361-TG	18:2738	OSTI (Free of Charge); INIS		TI93002390	MF-800
0362-TG	18:4329	OSTI (Free of Charge); INIS		TI93002393	MF-800
0363-SR	18:2739	OSTI (Free of Charge); INIS		TI93002387	MF-800
0364-SR	18:2740	OSTI (Free of Charge); INIS		TI93002386	MF-800
0364-TG	18:2741	OSTI (Free of Charge); INIS		TI93002392	MF-800
0374P	18:2699	INIS; OSTI (Free of Charge)		TI93003625	MF-800
DOE/S–					
0096P	18:3461	OSTI; NTIS; GPO Dep.	E 1.99:	DE93001379	MF-900
0101P	18:3462	OSTI (Free of Charge)		TI93003329	PC-960
DPSP–					
69-1172-Del.Ver.	18:3102	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93002408	MF-704
DPST–					
82-581	18:2678	OSTI; NTIS; GPO Dep.	E 1.99:	DE93000473	MF-702
87-341	18:4125	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93000592	MF-702
DPW–					
53-639	18:3107	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93002717	MF-700
53-650	18:3108	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93002718	MF-700
53-652	18:2679	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93002721	MF-700
53-654	18:3109	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93002722	MF-700
53-656	18:3110	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93002723	MF-700
53-7-2	18:3103	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93001917	MF-700
53-7-5	18:3104	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93002370	MF-700
53-7-10	18:3105	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93002369	MF-700
53-7-11	18:3106	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93002368	MF-700
5385	18:3111	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93001454	MF-700
5471	18:3057	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93001463	MF-700
5477	18:3112	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93001909	MF-700
5489	18:3113	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93001910	MF-700
5513	18:3114	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93001912	MF-700
5540	18:3300	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93001914	MF-700
5695	18:3115	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93000663	MF-700
5801	18:3116	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93001234	MF-700
5910	18:3301	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93001237	MF-700
6761	18:3058	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93002376	MF-706
6780	18:3117	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93002374	MF-700
6803	18:2680	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93002373	MF-700
DUN–					
1139	18:2816	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93000316	MF-502
7211	18:3088	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93000320	MF-520
ECN-C–					
92-018	18:2958	OSTI; NTIS (US Sales Only)		DE92557247	
92-019	18:3498	OSTI; NTIS (US Sales Only)		DE92557249	
92-030	18:3517	OSTI; NTIS (US Sales Only)		DE92557251	
92-034	18:3518	OSTI; NTIS (US Sales Only)		DE92557252	
92-037	18:3519	OSTI; NTIS (US Sales Only)		DE92557272	
92-039	18:2959	OSTI; NTIS (US Sales Only)		DE92557283	
ECN-I–					
92-030	18:3463	OSTI; NTIS (US Sales Only)		DE92557276	
ECN-RX–					
92-023	18:4612	OSTI; NTIS; INIS		DE93608467	
92-025	18:4126	OSTI; NTIS (US Sales Only)		DE92557266	
92-026	18:3471	OSTI; NTIS (US Sales Only); INIS		DE92557265	
92-027	18:3652	OSTI; NTIS (US Sales Only)		DE92557264	
92-028	18:3653	OSTI; NTIS (US Sales Only)		DE92557267	
92-029	18:3654	OSTI; NTIS (US Sales Only)		DE92557263	
92-032	18:3542	OSTI; NTIS (US Sales Only)		DE92557271	
EGG–					
10617-1082	18:4127	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93003328	MF-702

Report Number	Abstract Number	Source of Availability	GPO Dep.	Order Number	Distribution Category
10617-1150	18:4128	OSTI; NTIS (documentation only); ESTSC (complete software package), P.O. Box 1020, Oak Ridge, TN 37831-1020; GPO Dep.	E 1.99:	DE93000952	MF-902
10617-1152	18:4129	OSTI; NTIS (documentation only); ESTSC (complete software package), P.O. Box 1020, Oak Ridge, TN 37831-1020; GPO Dep.	E 1.99:	DE93000954	MF-902
10617-1154	18:4185	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93003327	MF-702
10617-2147	18:2620	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93001566	MF-126
EGG-BNCT–					
10016-03/04	18:4282	OSTI; NTIS; GPO Dep.	E 1.99:	DE93001931	MF-408
EGG-CODP–					
10030(9-92)	18:4784	OSTI; NTIS; GPO Dep.	E 1.99:	DE93001961	MF-505
EGG-EAST–					
9803	18:3118	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93001942	MF-700
9878	18:3119	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93001926	MF-700
EGG-FSP–					
10323	18:4745	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93001928	MF-425
10341	18:3581	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93001927	MF-425
10346	18:3582	OSTI; NTIS; GPO Dep.	E 1.99:	DE93001960	MF-404
10396	18:4746	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93001921	MF-425
EGG-HFRU–					
10214	18:3049	OSTI; NTIS; GPO Dep.	E 1.99:	DE93001962	
EGG-M–					
92072	18:3120	OSTI; NTIS; GPO Dep.	E 1.99:	DE93001958	MF-500
92101	18:3910	OSTI; NTIS; GPO Dep.	E 1.99:	DE93001957	MF-406; MF-405
92280	18:3625	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93001924	MF-404
92391	18:3302	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93001967	
92423	18:3303	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93001966	
92431	18:3911	*See* GA-A–20763			
92432	18:3912	*See* GA-A–20764			
92433	18:3913	*See* GA-A–20770			
EGG-MS–					
9869	18:3121	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93001959	MF-707
EGG-NRRT–					
10332	18:3304	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93002039	MF-520
10350	18:3122	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93002038	MF-520
EGG-PHY–					
10394	18:3561	OSTI; NTIS; GPO Dep.	E 1.99:	DE93001940	MF-700
ENEL-CRTN-G11–					
89-10	18:2965	OSTI; NTIS (US Sales Only)		DE93729462	
90-07	18:3583	OSTI; NTIS (US Sales Only)		DE93729408	
ENEL-CRTN-G14–					
91-02	18:3543	OSTI; NTIS (US Sales Only)		DE93729463	
ENEL-CRTN-G8–					
91-01	18:2941	OSTI; NTIS (US Sales Only)		DE93729398	
ENEL-CRTN-T11–					
91-10	18:3584	OSTI; NTIS (US Sales Only)		DE93729440	
92-02	18:3585	OSTI; NTIS (US Sales Only)		DE93729399	
ENEL-CRTN-T6–					
91-08	18:2976	OSTI; NTIS (US Sales Only)		DE93729450	
91-12	18:2966	OSTI; NTIS (US Sales Only)		DE93729439	
ENET–					
9100285/3	18:2939	OSTI; NTIS; ENET Administration und Versand, Postfach 142, CH-3000 Bern 6, Switzerland		DE93729850	
ES/ER/TM–					
26/R1	18:4186	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93000788	MF-902
38	18:2817	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93001933	MF-902; MF-907
39	18:4830	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE92041219	MF-902
4/R2	18:2840	OSTI; NTIS; GPO Dep.	E 1.99:	DE92040849	MF-902
42	18:2841	OSTI; NTIS; GPO Dep.	E 1.99:	DE92041015	MF-902
ESTSC–					
000140IBMPC01	18:4785	ESTSC			
000197IBMPC02	18:4786	ESTSC			
000349IBMPC01	18:4787	ESTSC			
000429IPCAT00	18:4788	ESTSC			
000536IBMPC00	18:4789	ESTSC			
000538I036000	18:4790	ESTSC			
000539I036000	18:4791	RADIATION SHIELDING INFORMATION CENTER			

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000540CY00100	18:4792	RADIATION SHIELDING INFORMATION CENTER			
000541C660000	18:4793	RADIATION SHIELDING INFORMATION CENTER			
000542H600000	18:4794	RADIATION SHIELDING INFORMATION CENTER			
000543I036000	18:4795	RADIATION SHIELDING INFORMATION CENTER			
000544C760000	18:4796	ESTSC			
000544I037000	18:4797	ESTSC			
ETDE-IT–					
92-75	18:3946	OSTI; NTIS (US Sales Only)		DE93729396	
92-77	18:2950	OSTI; NTIS (US Sales Only)		DE93729406	
92-79	18:2742	OSTI; NTIS (US Sales Only); INIS		DE93729471	
92-83	18:3447	OSTI; NTIS (US Sales Only)		DE93729444	
92-85	18:4239	OSTI; NTIS (US Sales Only); INIS		DE93729477	
92-87	18:3448	OSTI; NTIS (US Sales Only)		DE93729447	
92-91	18:3586	OSTI; NTIS (US Sales Only); INIS		DE93729479	
92-93	18:3551	OSTI; NTIS (US Sales Only)		DE93729460	
92-94	18:3505	OSTI; NTIS (US Sales Only)		DE93729461	
92-96	18:2908	OSTI; NTIS (US Sales Only)		DE93729465	
ETDE-mf–					
93728688	18:4102	OSTI; NTIS (US Sales Only)		DE93728688	
93728727	18:2597	OSTI; NTIS (US Sales Only)		DE93728727	
93728736	18:3544	OSTI; NTIS (US Sales Only)		DE93728736	
93728739	18:3472	OSTI; NTIS (US Sales Only)		DE93728739	
93728742	18:2568	OSTI; NTIS (US Sales Only)		DE93728742	
93728759	18:2951	OSTI; NTIS (US Sales Only)		DE93728759	
93728807	18:3504	OSTI; NTIS (US Sales Only)		DE93728807	
93728810	18:4187	OSTI; NTIS (US Sales Only)		DE93728810	
93728811	18:4240	OSTI; NTIS (US Sales Only)		DE93728811	
93728814	18:4130	OSTI; NTIS (US Sales Only)		DE93728814	
93728815	18:4241	OSTI; NTIS (US Sales Only)		DE93728815	
93728906	18:2552	OSTI; NTIS (US Sales Only)		DE93728906	
93728954	18:4386	OSTI; NTIS (US Sales Only)		DE93728954	
93728981	18:3796	OSTI; NTIS (US Sales Only)		DE93728981	
ETSU-S–					
1323	18:2942	OSTI; NTIS (US Sales Only)		DE93733558	
ETSU-SSH–					
4051	18:2909	OSTI; NTIS (US Sales Only)		DE93733560	
ETSU-WN–					
6015	18:2952	OSTI; NTIS (US Sales Only)		DE93733561	
6042	18:2953	OSTI; NTIS (US Sales Only)		DE93733562	
EUR–					
14514	18:4604	*See* NEANDC(E)–332-U-Vol.3-EURATOM			
FAW-TR–					
92007	18:4831	OSTI; NTIS (US Sales Only)		DE93728835	
FCR–					
12285	18:3513	*See* DOE/MC/24221–3143			
12321A	18:3512	*See* DOE/MC/24221–3130			
12328	18:3514	*See* DOE/MC/27393–3125			
FE-MIT–					
89773-9	18:2569	OSTI; NTIS; GPO Dep.	E 1.99:	DE93002947	MF-104
FERMILAB-PUB–					
92/228-A	18:4512	*See* DOE/ER/40682–15			
FNAL-TM–					
1797	18:3998	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93003115	MF-414
FNAL/C–					
92/163	18:4798	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE92018311	MF-414; MF-405
92/238	18:3996	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93001950	MF-414
92/240	18:3997	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93001951	MF-414
92/241	18:3978	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93001952	MF-414
FNAL/Pub–					
92/32-A	18:4455	*See* DOE/ER/40682–20			
92/34-A	18:4489	*See* DOE/ER/40682–19			
FSEC-CR–					
566-92	18:3525	*See* DOE/CE/21002–T1			
FhG-IzfP–					
910212-TW	18:3947	OSTI; NTIS (US Sales Only)		DE93728689	

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GA-A–					
20763	18:3911	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93001925	MF-820
20764	18:3912	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93001945	MF-820
20770	18:3913	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93001946	MF-820
21016	18:4747	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93001357	MF-420
21036	18:4748	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93000877	MF-421
21041	18:4712	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93001908	MF-422
21079	18:3018	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93001419	MF-522
GB–					
448	18:3473	OSTI; NTIS (US Sales Only); INIS		DE93733559	
GKSS–					
91/E/92	18:3587	OSTI; NTIS (US Sales Only); INIS		DE93728732	
91/E/95	18:3797	OSTI; NTIS (US Sales Only)		DE93728956	
92/E/1	18:4761	OSTI; NTIS (US Sales Only); INIS		DE93728955	
92/E/11	18:4054	OSTI; NTIS (US Sales Only)		DE93728986	
92/E/12	18:4131	OSTI; NTIS (US Sales Only)		DE93728907	
GRI–					
91/0280	18:2627	OSTI; NTIS; GPO Dep.	E 1.99:	DE93002267	
GSF–					
31/91	18:2743	OSTI; NTIS (US Sales Only); INIS		DE93728687	
39/91	18:2744	OSTI; NTIS (US Sales Only); INIS		DE93728728	
GSF-TL–					
23/91	18:2743	*See* GSF–31/91			
34/91	18:2744	*See* GSF–39/91			
GSI–					
92-17(prepr.)	18:4613	OSTI; NTIS (US Sales Only); INIS		DE93728959	
92-18(prepr.)	18:4585	OSTI; NTIS (US Sales Only); INIS		DE93728962	
92-23(prepr.)	18:4614	OSTI; NTIS (US Sales Only); INIS		DE93728958	
92-25(prepr.)	18:3971	OSTI; NTIS (US Sales Only); INIS		DE93728960	
92-35(prepr.)	18:4615	OSTI; NTIS (US Sales Only); INIS		DE93728820	
92-36(prepr.)	18:4616	OSTI; NTIS (US Sales Only); INIS		DE93728816	
92-39(prepr.)	18:4601	OSTI; NTIS (US Sales Only); INIS		DE93728817	
92-41(prepr.)	18:4617	OSTI; NTIS (US Sales Only); INIS		DE93728819	
92-49(prepr.)	18:4665	OSTI; NTIS (US Sales Only); INIS		DE93728899	
92-51(prepr.)	18:4548	OSTI; NTIS (US Sales Only); INIS		DE93729017	
92-52(prepr.)	18:4618	OSTI; NTIS (US Sales Only); INIS		DE93729016	
92-53(prepr.)	18:4619	OSTI; NTIS (US Sales Only); INIS		DE93728929	
92-55(prepr.)	18:4491	OSTI; NTIS (US Sales Only); INIS		DE93729008	
92-56(prepr.)	18:4620	OSTI; NTIS (US Sales Only); INIS		DE93729009	
92-60(prepr.)	18:4647	OSTI; NTIS (US Sales Only); INIS		DE93729011	
HIFAN–					
538	18:4752	*See* LBL–32213			
HUTP–					
92/A032	18:4512	*See* DOE/ER/40682–15			
92A010	18:4455	*See* DOE/ER/40682–20			
92A011	18:4489	*See* DOE/ER/40682–19			
HW–					
10232	18:3132	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93000983	MF-520
11426	18:3133	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93002063	MF-520
12863	18:2842	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93002580	MF-500
13184	18:3134	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93002141	MF-520
19417	18:2700	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93002064	MF-520
19739	18:2681	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93002496	MF-500
20342	18:3135	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93002142	MF-520
20379	18:3136	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93002066	MF-520
20425	18:3137	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93002067	MF-520
20841	18:3138	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93002143	MF-520
21728	18:3139	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93002069	MF-520
24191	18:3305	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93002144	MF-520
24273	18:3140	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93002074	MF-520
24848	18:3141	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93002145	MF-520
25012	18:3142	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93002076	MF-520
25345	18:3143	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93002146	MF-711
25431	18:3073	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93002075	MF-520
25618	18:3144	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93002147	MF-520
25704	18:3145	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93002077	MF-520
26083	18:3074	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93002148	MF-520
26395	18:3146	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93002149	MF-520
27318	18:3147	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93002079	MF-520
27392	18:3148	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93002151	MF-520
27778	18:3149	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93002080	MF-520

Report Number	Abstract Number	Source of Availability	GPO Dep.	Order Number	Distribution Category
28076	18:3150	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93002068	MF-520
3-2661	18:3123	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93000328	MF-500
30000-Del.	18:3151	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93000323	MF-520
30751	18:3306	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93001729	MF-600
33998-RD	18:3152	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93001731	MF-600
34328-RD	18:3307	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93001733	MF-600
39900-Del.	18:3153	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93000324	MF-520
41205-Del.	18:2658	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93002502	MF-500
44580-Del.	18:3154	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93000765	MF-500
44708-Vol.1-Rev.	18:3308	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93000325	MF-520
49419-Del.	18:2659	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93001331	MF-500
49752-Del.	18:2660	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93002087	MF-500
51234-Del.	18:2661	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93000998	MF-500
52303-Del.	18:2662	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93001776	MF-500
53355-Del.	18:3155	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93002441	MF-510
54821-Del.	18:2682	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93002497	MF-500
55905	18:3156	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93002504	MF-500
55914-Del.	18:2683	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93001777	MF-500
56229	18:3157	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93003519	MF-500
60846-Del.	18:3158	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93000769	MF-500
61206	18:3089	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93002081	MF-520
61374	18:3159	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93002505	MF-500
62012	18:2663	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93001778	MF-500
62471	18:3309	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93000326	MF-520
62593-Del.	18:2684	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93001779	MF-500
63303	18:2664	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93001780	MF-500
63351	18:3160	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93000333	MF-711
63706-Del.	18:2685	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93001781	MF-500
64089-Del.	18:2686	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93001782	MF-500
64108	18:2665	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93002499	MF-500
64555-Del.	18:3161	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93002442	MF-700
65013	18:3162	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93001740	MF-700
65527	18:3163	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93000991	MF-700
65854-Del.	18:2666	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93002500	MF-500
66296	18:3164	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93001741	MF-700
66958-Del.	18:2687	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93001335	MF-500
66960-Del.	18:2667	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93001336	MF-500
67262	18:3165	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93000327	MF-520
67532	18:2668	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93001785	MF-500
67700-Del.	18:2669	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93001232	MF-500
69062	18:2670	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93002088	MF-500
69803	18:2688	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93002089	MF-500
69835	18:3166	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93003174	MF-700
7-1936	18:3124	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93002056	MF-520
7-1948	18:3125	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93002057	MF-520
7-2744	18:3126	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93002106	MF-520
7-3212	18:3071	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93002058	MF-520
7-3337	18:3127	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93002105	MF-520
7-3834	18:3128	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93002059	MF-520
7-4558	18:3072	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93002060	MF-520
71584	18:3167	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93001742	MF-700
7197	18:3129	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93002061	MF-520
72179	18:3168	OSTI; NTIS; GPO Dep.	E 1.99:	DE93003571	MF-700
73153	18:3169	OSTI; NTIS; GPO Dep.	E 1.99:	DE93003572	MF-700
76109	18:2701	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93002084	MF-513
76327	18:3075	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93002082	MF-520
76886	18:3310	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93002085	MF-520
79792	18:3311	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93002086	MF-520
9602	18:3130	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93000329	MF-520
9603	18:3131	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93002062	MF-520
IAE–					
2091/R-5/D/A	18:4028	OSTI; NTIS (US Sales Only); INIS		DE93607923	
2105/OBRI/I/A	18:4029	OSTI; NTIS (US Sales Only); INIS		DE93607845	
IAEA-CN–					
56/A-7-17	18:4729	*See* PPPL-CFP–2755			
56/B-2-3	18:4752	*See* LBL–32213			
56/E-2-5	18:4730	*See* PPPL-CFP–2756			
IAEA-INES–					
92/01	18:3090	OSTI; NTIS (US Sales Only); INIS		DE93607695	
IAEA-NAHRES–					
3	18:3673	OSTI; NTIS (US Sales Only); INIS		DE93606507	

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5	18:3685	OSTI; NTIS (US Sales Only); INIS		DE93606549	
6	18:3686	OSTI; NTIS (US Sales Only); INIS		DE93606508	
7	18:3707	OSTI; NTIS (US Sales Only); INIS		DE93606502	
8	18:4303	OSTI; NTIS (US Sales Only); INIS		DE93607313	
9	18:3716	OSTI; NTIS (US Sales Only); INIS		DE93606509	
10	18:4317	OSTI; NTIS (US Sales Only); INIS		DE93607312	
IAEA-TECDOC–					
643(v.1)	18:3170	OSTI; NTIS (US Sales Only); INIS		DE93607811	
643(v.2)	18:3171	OSTI; NTIS (US Sales Only); INIS		DE93607344	
643(v.3)	18:3191	OSTI; NTIS (US Sales Only); INIS		DE93607812	
643(v.4)	18:3220	OSTI; NTIS (US Sales Only); INIS		DE93607813	
643(v.5)	18:3270	OSTI; NTIS (US Sales Only); INIS		DE93607574	
650	18:2720	OSTI; NTIS (US Sales Only); INIS		DE93607128	
660	18:4799	OSTI; NTIS (US Sales Only); INIS		DE93606682	
IBP-GB–					
70/91	18:3526	OSTI; NTIS (US Sales Only)		DE93728730	
71/91	18:3527	OSTI; NTIS (US Sales Only)		DE93728731	
72/91	18:3528	OSTI; NTIS (US Sales Only)		DE93728729	
IC–					
92/150	18:4492	OSTI; NTIS (US Sales Only); INIS		DE93608192	
92/163	18:3941	OSTI; NTIS (US Sales Only); INIS		DE93607560	
92/175	18:4682	OSTI; NTIS (US Sales Only); INIS		DE93608677	
92/178	18:4436	OSTI; NTIS (US Sales Only); INIS		DE93608159	
92/181	18:4493	OSTI; NTIS (US Sales Only); INIS		DE93608193	
92/188	18:4437	OSTI; NTIS (US Sales Only); INIS		DE93608160	
92/194	18:4438	OSTI; NTIS (US Sales Only); INIS		DE93608161	
92/199	18:4568	OSTI; NTIS (US Sales Only); INIS		DE93608399	
92/202	18:4514	OSTI; NTIS (US Sales Only); INIS		DE93608298	
92/203	18:4494	OSTI; NTIS (US Sales Only); INIS		DE93608194	
92/204	18:3588	OSTI; NTIS (US Sales Only); INIS		DE93606724	
92/205	18:3589	OSTI; NTIS (US Sales Only); INIS		DE93606725	
92/206	18:4666	OSTI; NTIS (US Sales Only); INIS		DE93608535	
92/207	18:4667	OSTI; NTIS (US Sales Only); INIS		DE93608536	
92/208	18:4456	OSTI; NTIS (US Sales Only); INIS		DE93608185	
92/209	18:4549	OSTI; NTIS (US Sales Only); INIS		DE93608349	
92/210	18:4495	OSTI; NTIS (US Sales Only); INIS		DE93608191	
92/211	18:4691	OSTI; NTIS (US Sales Only); INIS		DE93608697	
92/212	18:4496	OSTI; NTIS (US Sales Only); INIS		DE93608195	
92/213	18:4515	OSTI; NTIS (US Sales Only); INIS		DE93608263	
92/214	18:4439	OSTI; NTIS (US Sales Only); INIS		DE93608162	
92/215	18:4440	OSTI; NTIS (US Sales Only); INIS		DE93608163	
92/216	18:4516	OSTI; NTIS (US Sales Only); INIS		DE93608264	
92/217	18:4441	OSTI; NTIS (US Sales Only); INIS		DE93608164	
92/218	18:4672	OSTI; NTIS (US Sales Only); INIS		DE93608542	
92/220	18:4497	OSTI; NTIS (US Sales Only); INIS		DE93608196	
92/226	18:4498	OSTI; NTIS (US Sales Only); INIS		DE93608197	
92/229	18:4692	OSTI; NTIS (US Sales Only); INIS		DE93608698	
92/230	18:3800	OSTI; NTIS (US Sales Only); INIS		DE93606577	
92/231	18:4648	OSTI; NTIS (US Sales Only); INIS		DE93608512	
92/232	18:4442	OSTI; NTIS (US Sales Only); INIS		DE93608165	
92/235	18:4654	OSTI; NTIS (US Sales Only); INIS		DE93608520	
92/236	18:4649	OSTI; NTIS (US Sales Only); INIS		DE93608513	
92/237	18:4569	OSTI; NTIS (US Sales Only); INIS		DE93608377	
92/238	18:4499	OSTI; NTIS (US Sales Only); INIS		DE93608198	
92/239	18:4443	OSTI; NTIS (US Sales Only); INIS		DE93608166	
92/240	18:4457	OSTI; NTIS (US Sales Only); INIS		DE93608186	
92/241	18:4500	OSTI; NTIS (US Sales Only); INIS		DE93608199	
92/242	18:4650	OSTI; NTIS (US Sales Only); INIS		DE93608514	
92/243	18:4655	OSTI; NTIS (US Sales Only); INIS		DE93608521	
92/244	18:4700	OSTI; NTIS (US Sales Only); INIS		DE93608737	
92/245	18:4621	OSTI; NTIS (US Sales Only); INIS		DE93608480	
92/246	18:4458	OSTI; NTIS (US Sales Only); INIS		DE93608187	
92/247	18:4656	OSTI; NTIS (US Sales Only); INIS		DE93608522	
92/248	18:4501	OSTI; NTIS (US Sales Only); INIS		DE93608200	
92/249	18:4651	OSTI; NTIS (US Sales Only); INIS		DE93608515	
92/250	18:4684	OSTI; NTIS (US Sales Only); INIS		DE93608691	
92/251	18:4685	OSTI; NTIS (US Sales Only); INIS		DE93608692	
92/252	18:4686	OSTI; NTIS (US Sales Only); INIS		DE93608693	
92/253	18:4713	OSTI; NTIS (US Sales Only); INIS		DE93608560	
92/256	18:4714	OSTI; NTIS (US Sales Only); INIS		DE93608570	
92/257	18:4715	OSTI; NTIS (US Sales Only); INIS		DE93608571	

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92/259	18:4459	OSTI; NTIS (US Sales Only); INIS		DE93608188	
92/98	18:4189	OSTI; NTIS (US Sales Only); INIS		DE93607100	
IEN–					
22/91	18:3942	OSTI; NTIS (US Sales Only); INIS		DE93607561	
33/92	18:3279	OSTI; NTIS (US Sales Only); INIS		DE93607814	
35/92	18:3044	OSTI; NTIS (US Sales Only); INIS		DE93607641	
IEN-DERE-DIFIR–					
011/89	18:3914	OSTI; NTIS (US Sales Only); INIS		DE93607565	
IEN-DERE-DIMEC–					
06/85	18:4804	OSTI; NTIS (US Sales Only); INIS		DE93608125	
IEN-DIAPQ–					
001/89	18:4190	OSTI; NTIS (US Sales Only); INIS		DE93607113	
IFP–					
39560	18:3953	OSTI; NTIS (US Sales Only)		DE93721311	
IFT-P–					
010/92	18:4586	OSTI; NTIS (US Sales Only); INIS		DE93608412	
011/92	18:4517	OSTI; NTIS (US Sales Only); INIS		DE93608282	
012/92	18:4502	OSTI; NTIS (US Sales Only); INIS		DE93608201	
013/92	18:4518	OSTI; NTIS (US Sales Only); INIS		DE93608265	
015/92	18:4602	OSTI; NTIS (US Sales Only); INIS		DE93608450	
045/91	18:4503	OSTI; NTIS (US Sales Only); INIS		DE93608244	
IHEP-OTF–					
90-191	18:4570	OSTI; NTIS (US Sales Only); INIS		DE93608375	
IKDA–					
92/23	18:4541	*See* DESY–92-113			
IKE–					
6-139	18:3948	OSTI; NTIS (US Sales Only); INIS		DE93729133	
INDC(CUB)–					
005/G	18:4622	OSTI; NTIS (US Sales Only); INIS		DE93608468	
006/G	18:4587	OSTI; NTIS (US Sales Only); INIS		DE93608413	
INDC(EUR)–					
026/G	18:4604	*See* NEANDC(E)–332-U-Vol.3-EURATOM			
INDC(NDS)–					
250/G,ND	18:4588	OSTI; NTIS (US Sales Only); INIS		DE93608410	
INIS-BR–					
2938	18:3737	OSTI; NTIS (US Sales Only); INIS		DE93606510	
2943	18:3752	OSTI; NTIS (US Sales Only); INIS		DE93606511	
2944	18:3753	OSTI; NTIS (US Sales Only); INIS		DE93606512	
2945	18:4444	OSTI; NTIS (US Sales Only); INIS		DE93608167	
2946	18:2998	OSTI; NTIS (US Sales Only); INIS		DE93607753	
2947	18:3943	OSTI; NTIS (US Sales Only); INIS		DE93607562	
2948	18:3023	OSTI; NTIS (US Sales Only); INIS		DE93607798	
2950	18:2652	OSTI; NTIS (US Sales Only); INIS		DE93607129	
2951	18:3282	OSTI; NTIS (US Sales Only); INIS		DE93607815	
2953	18:3590	OSTI; NTIS (US Sales Only); INIS		DE93606708	
2954	18:2985	OSTI; NTIS (US Sales Only); INIS		DE93607701	
2955	18:3591	OSTI; NTIS (US Sales Only); INIS		DE93606738	
2956	18:2999	OSTI; NTIS (US Sales Only); INIS		DE93607754	
2957	18:4318	OSTI; NTIS (US Sales Only); INIS		DE93607314	
2958	18:4330	OSTI; NTIS (US Sales Only); INIS		DE93607212	
2959	18:4331	OSTI; NTIS (US Sales Only); INIS		DE93607261	
2960	18:4332	OSTI; NTIS (US Sales Only); INIS		DE93607205	
2961	18:4333	OSTI; NTIS (US Sales Only); INIS		DE93607206	
2962	18:4334	OSTI; NTIS (US Sales Only); INIS		DE93607366	
2963	18:3801	OSTI; NTIS (US Sales Only); INIS		DE93606578	
2964	18:3802	OSTI; NTIS (US Sales Only); INIS		DE93606579	
2965	18:4242	OSTI; NTIS (US Sales Only); INIS		DE93607151	
2966	18:4192	OSTI; NTIS (US Sales Only); INIS		DE93607114	
2967	18:4335	OSTI; NTIS (US Sales Only); INIS		DE93607213	
2968	18:3754	OSTI; NTIS (US Sales Only); INIS		DE93606550	
2969	18:4193	OSTI; NTIS (US Sales Only); INIS		DE93607115	
2970	18:4030	OSTI; NTIS (US Sales Only); INIS		DE93607924	
2971	18:3000	OSTI; NTIS (US Sales Only); INIS		DE93607755	
2972	18:4640	OSTI; NTIS (US Sales Only); INIS		DE93608500	
2973	18:3001	OSTI; NTIS (US Sales Only); INIS		DE93607756	
2974	18:3002	OSTI; NTIS (US Sales Only); INIS		DE93607757	
2975	18:3045	OSTI; NTIS (US Sales Only); INIS		DE93607642	
2976	18:3283	OSTI; NTIS (US Sales Only); INIS		DE93607816	
2977	18:3046	OSTI; NTIS (US Sales Only); INIS		DE93607643	
2978	18:3003	OSTI; NTIS (US Sales Only); INIS		DE93607758	
2980	18:3004	OSTI; NTIS (US Sales Only); INIS		DE93607759	

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2981	18:4336	OSTI; NTIS (US Sales Only); INIS		DE93607367	
2982	18:4641	OSTI; NTIS (US Sales Only); INIS		DE93607644	
2983	18:4701	OSTI; NTIS (US Sales Only); INIS		DE93608738	
2984	18:2654	OSTI; NTIS (US Sales Only); INIS		DE93606678	
2985	18:3592	OSTI; NTIS (US Sales Only); INIS		DE93606716	
2986	18:4337	OSTI; NTIS (US Sales Only); INIS		DE93607199	
2987	18:3626	OSTI; NTIS (US Sales Only); INIS		DE93606831	
2988	18:3627	OSTI; NTIS (US Sales Only); INIS		DE93606893	
2989	18:3628	OSTI; NTIS (US Sales Only); INIS		DE93607029	
2990	18:4338	OSTI; NTIS (US Sales Only); INIS		DE93607368	
2992	18:4702	OSTI; NTIS (US Sales Only); INIS		DE93608739	
2993	18:3891	OSTI; NTIS (US Sales Only); INIS		DE93606609	
2999	18:3803	OSTI; NTIS (US Sales Only); INIS		DE93606580	
3000	18:3755	OSTI; NTIS (US Sales Only); INIS		DE93606551	
3002	18:3804	OSTI; NTIS (US Sales Only); INIS		DE93606582	
3003	18:4283	OSTI; NTIS (US Sales Only); INIS		DE93607533	
3004	18:4339	OSTI; NTIS (US Sales Only); INIS		DE93607232	
3005	18:4031	OSTI; NTIS (US Sales Only); INIS		DE93607925	
3006	18:4340	OSTI; NTIS (US Sales Only); INIS		DE93607233	
3007	18:4319	OSTI; NTIS (US Sales Only); INIS		DE93607315	
3008	18:4341	OSTI; NTIS (US Sales Only); INIS		DE93607262	
3010	18:4342	OSTI; NTIS (US Sales Only); INIS		DE93607200	
3013	18:4194	OSTI; NTIS (US Sales Only); INIS		DE93607116	
3014	18:3756	OSTI; NTIS (US Sales Only); INIS		DE93606513	
3015	18:4243	OSTI; NTIS (US Sales Only); INIS		DE93607152	
3016	18:4343	OSTI; NTIS (US Sales Only); INIS		DE93607263	
3017	18:4344	OSTI; NTIS (US Sales Only); INIS		DE93607264	
3018	18:4195	OSTI; NTIS (US Sales Only); INIS		DE93607117	
3019	18:4032	OSTI; NTIS (US Sales Only); INIS		DE93607834	
3020	18:4657	OSTI; NTIS (US Sales Only); INIS		DE93608523	
3021	18:4345	OSTI; NTIS (US Sales Only); INIS		DE93607265	
3022	18:4320	OSTI; NTIS (US Sales Only); INIS		DE93607297	
3023	18:3005	OSTI; NTIS (US Sales Only); INIS		DE93607760	
3024	18:4284	OSTI; NTIS (US Sales Only); INIS		DE93607540	
3025	18:4346	OSTI; NTIS (US Sales Only); INIS		DE93607541	
3026	18:3097	OSTI; NTIS (US Sales Only); INIS		DE93607333	
3027	18:3757	OSTI; NTIS (US Sales Only); INIS		DE93606552	
3028	18:4347	OSTI; NTIS (US Sales Only); INIS		DE93607369	
3029	18:3892	OSTI; NTIS (US Sales Only); INIS		DE93606616	
3030	18:4603	OSTI; NTIS (US Sales Only); INIS		DE93608451	
3032	18:4348	OSTI; NTIS (US Sales Only); INIS		DE93607214	
3033	18:4504	OSTI; NTIS (US Sales Only); INIS		DE93608202	
3034	18:4285	OSTI; NTIS (US Sales Only); INIS		DE93607534	
3035	18:4716	OSTI; NTIS (US Sales Only); INIS		DE93608572	
3036	18:3027	OSTI; NTIS (US Sales Only); INIS		DE93607824	
3037	18:4680	OSTI; NTIS (US Sales Only); INIS		DE93608607	
3038	18:2655	OSTI; NTIS (US Sales Only); INIS		DE93606679	
3039	18:4244	OSTI; NTIS (US Sales Only); INIS		DE93607149	
3040	18:3758	OSTI; NTIS (US Sales Only); INIS		DE93606514	
3041	18:3593	OSTI; NTIS (US Sales Only); INIS		DE93606709	
3042	18:4832	OSTI; NTIS (US Sales Only); INIS		DE93608118	
3043	18:4349	OSTI; NTIS (US Sales Only); INIS		DE93607234	
3044	18:4350	OSTI; NTIS (US Sales Only); INIS		DE93607235	
3045	18:4033	OSTI; NTIS (US Sales Only); INIS		DE93607835	
3046	18:4505	OSTI; NTIS (US Sales Only); INIS		DE93608245	
3047	18:4351	OSTI; NTIS (US Sales Only); INIS		DE93607215	
3048	18:3594	OSTI; NTIS (US Sales Only); INIS		DE93606710	
3049	18:4196	OSTI; NTIS (US Sales Only); INIS		DE93607104	
3050	18:4352	OSTI; NTIS (US Sales Only); INIS		DE93607218	
3051	18:4658	OSTI; NTIS (US Sales Only); INIS		DE93608524	
3052	18:4353	OSTI; NTIS (US Sales Only); INIS		DE93606611	
3053	18:4766	OSTI; NTIS (US Sales Only); INIS		DE93608132	
3054	18:3006	OSTI; NTIS (US Sales Only); INIS		DE93607761	
3055	18:3805	OSTI; NTIS (US Sales Only); INIS		DE93606583	
3057	18:4354	OSTI; NTIS (US Sales Only); INIS		DE93607207	
3058	18:3047	OSTI; NTIS (US Sales Only); INIS		DE93607645	
3059	18:3284	OSTI; NTIS (US Sales Only); INIS		DE93607817	
INIS-GB–					
449	18:4767	OSTI; NTIS (US Sales Only); INIS		DE93608133	
450	18:4768	OSTI; NTIS (US Sales Only); INIS		DE93608134	
451	18:4355	OSTI; NTIS (US Sales Only); INIS		DE93607350	

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INIS-mf–					
13365	18:3806	OSTI; NTIS (US Sales Only); INIS		DE93606584	
13369	18:3484	OSTI; NTIS (US Sales Only); INIS		DE93607987	
13373	18:2848	OSTI; NTIS (US Sales Only); INIS		DE93608119	
13375	18:3285	OSTI; NTIS (US Sales Only); INIS		DE93606515	
13377	18:4771	OSTI; NTIS (US Sales Only); INIS		DE93608135	
13378	18:3629	OSTI; NTIS (US Sales Only); INIS		DE93606832	
13379	18:4133	OSTI; NTIS (US Sales Only); INIS		DE93607159	
13380	18:3007	OSTI; NTIS (US Sales Only); INIS		DE93607762	
14085	18:4762	OSTI; NTIS (US Sales Only); INIS		DE93728679	
14091	18:4197	OSTI; NTIS (US Sales Only); INIS		DE93729096	
14092	18:4198	OSTI; NTIS (US Sales Only); INIS		DE93729097	
INP–					
1480/PL	18:3967	OSTI; NTIS (US Sales Only); INIS		DE93607605	
1504/PH	18:4519	OSTI; NTIS (US Sales Only); INIS		DE93608299	
1506/PL	18:3972	OSTI; NTIS (US Sales Only); INIS		DE93607607	
1507/PL	18:3968	OSTI; NTIS (US Sales Only); INIS		DE93607606	
1518/PH	18:4520	OSTI; NTIS (US Sales Only); INIS		DE93608286	
1530/PL	18:4000	OSTI; NTIS (US Sales Only); INIS		DE93607618	
1532/PH	18:4625	OSTI; NTIS (US Sales Only); INIS		DE93608475	
1533/PH	18:4626	OSTI; NTIS (US Sales Only); INIS		DE93608481	
1539/PL	18:4627	OSTI; NTIS (US Sales Only); INIS		DE93608482	
1540/PH	18:4550	OSTI; NTIS (US Sales Only); INIS		DE93608324	
1543/PL	18:4589	OSTI; NTIS (US Sales Only); INIS		DE93608434	
1553/PH	18:4445	OSTI; NTIS (US Sales Only); INIS		DE93608168	
1554/PH	18:4551	OSTI; NTIS (US Sales Only); INIS		DE93608325	
1556/PH	18:4446	OSTI; NTIS (US Sales Only); INIS		DE93608169	
1557/PH	18:4447	OSTI; NTIS (US Sales Only); INIS		DE93608170	
INPE–					
5255	18:4717	OSTI; NTIS (US Sales Only); INIS		DE93608544	
5256	18:4718	OSTI; NTIS (US Sales Only); INIS		DE93608552	
5257	18:4719	OSTI; NTIS (US Sales Only); INIS		DE93608553	
5372	18:3630	OSTI; NTIS (US Sales Only); INIS		DE93606833	
5384	18:4720	OSTI; NTIS (US Sales Only); INIS		DE93608548	
5403	18:4721	OSTI; NTIS (US Sales Only); INIS		DE93608554	
INT–					
242/PS	18:4448	OSTI; NTIS (US Sales Only); INIS		DE93608171	
250/PS	18:4722	OSTI; NTIS (US Sales Only); INIS		DE93608592	
254/PS	18:4723	OSTI; NTIS (US Sales Only); INIS		DE93608593	
IPEN-DT–					
2	18:4359	OSTI; NTIS (US Sales Only); INIS		DE93607266	
IPEN-PUB–					
355	18:3807	OSTI; NTIS (US Sales Only); INIS		DE93606585	
356	18:2690	OSTI; NTIS (US Sales Only); INIS		DE93606683	
357	18:2691	OSTI; NTIS (US Sales Only); INIS		DE93606684	
IRD-CNEN-NT–					
010/87	18:4805	OSTI; NTIS (US Sales Only); INIS		DE93608126	
IS-M–					
720	18:3655	OSTI; NTIS; GPO Dep.	E 1.99:	DE92018803	MF-706
IS-T–					
1134	18:3808	OSTI; NTIS; GPO Dep.	E 1.99:	DE93002526	MF-401
1628	18:3809	OSTI; NTIS; GPO Dep.	E 1.99:	DE93001218	MF-401
ITF–					
91-34	18:4571	OSTI; NTIS (US Sales Only); INIS		DE93608386	
91-36	18:4628	OSTI; NTIS (US Sales Only); INIS		DE93608461	
91-52	18:4629	OSTI; NTIS (US Sales Only); INIS		DE93608454	
91-72	18:4506	OSTI; NTIS (US Sales Only); INIS		DE93608203	
ITP–					
91-100	18:4556	OSTI; NTIS (US Sales Only); INIS		DE93608326	
91-28	18:4630	OSTI; NTIS (US Sales Only); INIS		DE93608469	
91-29	18:4507	OSTI; NTIS (US Sales Only); INIS		DE93608204	
91-34	18:4552	OSTI; NTIS (US Sales Only); INIS		DE93608327	
91-39	18:4521	OSTI; NTIS (US Sales Only); INIS		DE93608287	
91-42	18:4631	OSTI; NTIS (US Sales Only); INIS		DE93608470	
91-45	18:4553	OSTI; NTIS (US Sales Only); INIS		DE93608328	
91-46	18:4554	OSTI; NTIS (US Sales Only); INIS		DE93608350	
91-56	18:4632	OSTI; NTIS (US Sales Only); INIS		DE93608483	
91-64	18:4522	OSTI; NTIS (US Sales Only); INIS		DE93608288	
91-79	18:4523	OSTI; NTIS (US Sales Only); INIS		DE93608289	
91-82	18:4633	OSTI; NTIS (US Sales Only); INIS		DE93608484	
91-99	18:4555	OSTI; NTIS (US Sales Only); INIS		DE93608329	

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ITP-UH–					
3/92	18:4480	*See* DESY–92-018			
5/92	18:4510	*See* DESY–92-100			
IYaF–					
91-70	18:4001	OSTI; NTIS (US Sales Only); INIS		DE93605897	
JET-R–					
(92)-04	18:4749	OSTI; NTIS (US Sales Only); INIS		DE93608604	
(92)-05	18:4724	OSTI; NTIS (US Sales Only); INIS		DE93608545	
JINR-R–					
1-91-455	18:4634	OSTI; NTIS (US Sales Only); INIS		DE93608476	
14-91-458	18:3767	OSTI; NTIS (US Sales Only); INIS		DE93607555	
2-91-241	18:3595	OSTI; NTIS (US Sales Only); INIS		DE93606751	
Juel–					
2422	18:3656	OSTI; NTIS (US Sales Only); INIS		DE93729019	
2573	18:3077	OSTI; NTIS (US Sales Only); INIS		DE93728949	
2604	18:3290	OSTI; NTIS (US Sales Only); INIS		DE93728869	
2610	18:4360	OSTI; NTIS (US Sales Only); INIS		DE93728908	
2624	18:4199	OSTI; NTIS (US Sales Only)		DE93728904	
2628	18:3631	OSTI; NTIS (US Sales Only); INIS		DE93729053	
2634	18:2905	OSTI; NTIS (US Sales Only)		DE93729095	
2638	18:3039	OSTI; NTIS (US Sales Only); INIS		DE93728943	
K/GDP/SAR–					
3/R1	18:2657	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93002114	MF-502
K/TCD–					
1031	18:2760	OSTI; NTIS; GPO Dep.	E 1.99:	DE92040513	MF-902
KAERI-NEMAC/RR–					
29/91	18:2852	OSTI; NTIS (US Sales Only); INIS		DE93608104	
30/91	18:2853	OSTI; NTIS (US Sales Only); INIS		DE93608105	
32/91	18:2713	OSTI; NTIS (US Sales Only); INIS		DE93607575	
33/91	18:2714	OSTI; NTIS (US Sales Only); INIS		DE93607576	
34/91	18:2745	OSTI; NTIS (US Sales Only); INIS		DE93607944	
35/91	18:2746	OSTI; NTIS (US Sales Only); INIS		DE93607945	
36/91	18:2747	OSTI; NTIS (US Sales Only); INIS		DE93607946	
37/91	18:2748	OSTI; NTIS (US Sales Only); INIS		DE93607960	
38/91	18:4200	OSTI; NTIS (US Sales Only); INIS		DE93607140	
39/91	18:3769	OSTI; NTIS (US Sales Only); INIS		DE93607141	
40/91	18:2819	OSTI; NTIS (US Sales Only); INIS		DE93607153	
42/91	18:2749	OSTI; NTIS (US Sales Only); INIS		DE93607947	
43/91	18:2750	OSTI; NTIS (US Sales Only); INIS		DE93607961	
45/91	18:2715	OSTI; NTIS (US Sales Only); INIS		DE93607577	
46/91	18:2751	OSTI; NTIS (US Sales Only); INIS		DE93607948	
47/91	18:2752	OSTI; NTIS (US Sales Only); INIS		DE93607962	
49/91	18:2753	OSTI; NTIS (US Sales Only); INIS		DE93607963	
50/91	18:2754	OSTI; NTIS (US Sales Only); INIS		DE93607952	
51/91	18:2755	OSTI; NTIS (US Sales Only); INIS		DE93607953	
52/91	18:2756	OSTI; NTIS (US Sales Only); INIS		DE93607954	
53/91	18:2757	OSTI; NTIS (US Sales Only); INIS		DE93607964	
54/91	18:2758	OSTI; NTIS (US Sales Only); INIS		DE93607955	
56/91	18:2759	OSTI; NTIS (US Sales Only); INIS		DE93607965	
57/91	18:2693	OSTI; NTIS (US Sales Only); INIS		DE93606686	
KAERI/AR–					
333/91	18:3768	OSTI; NTIS (US Sales Only); INIS		DE93607553	
334/91	18:3949	OSTI; NTIS (US Sales Only); INIS		DE93607634	
335/91	18:3060	OSTI; NTIS (US Sales Only); INIS		DE93607669	
336/91	18:2692	OSTI; NTIS (US Sales Only); INIS		DE93606685	
337/91	18:2629	OSTI; NTIS (US Sales Only); INIS		DE93606677	
KAERI/RR–					
1024/91	18:3061	OSTI; NTIS (US Sales Only); INIS		DE93607670	
1049/91	18:2857	OSTI; NTIS (US Sales Only); INIS		DE93605710	
1061/91	18:4035	OSTI; NTIS (US Sales Only); INIS		DE93605838	
1072/91	18:3596	OSTI; NTIS (US Sales Only); INIS		DE93605682	
1084/91	18:4643	OSTI; NTIS (US Sales Only); INIS		DE93606181	
KAERI/TR–					
222/91	18:3008	OSTI; NTIS (US Sales Only); INIS		DE93607763	
223/91	18:3062	OSTI; NTIS (US Sales Only); INIS		DE93607671	
225/91	18:3063	OSTI; NTIS (US Sales Only); INIS		DE93607672	
236/91	18:3098	OSTI; NTIS (US Sales Only); INIS		DE93607340	
237/91	18:3078	OSTI; NTIS (US Sales Only); INIS		DE93607684	
238/92	18:3944	OSTI; NTIS (US Sales Only); INIS		DE93607563	
239/92	18:3064	OSTI; NTIS (US Sales Only); INIS		DE93607673	
240/91	18:3065	OSTI; NTIS (US Sales Only); INIS		DE93607674	

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244/92	18:3009	OSTI; NTIS (US Sales Only); INIS		DE93607764	
245/91	18:3066	OSTI; NTIS (US Sales Only); INIS		DE93607675	
247/91	18:4833	OSTI; NTIS (US Sales Only); INIS		DE93608117	
KAPL–					
4736	18:3028	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93000356	MF-507
KFK–					
4708	18:4644	OSTI; NTIS (US Sales Only); INIS		DE93729013	
4867	18:4834	OSTI; NTIS (US Sales Only); INIS		DE93729014	
4895	18:3915	OSTI; NTIS (US Sales Only); INIS		DE93728950	
4984	18:3632	OSTI; NTIS (US Sales Only); INIS		DE93742164	
4988	18:4693	OSTI; NTIS (US Sales Only); INIS		DE93742166	
4989	18:3024	OSTI; NTIS (US Sales Only); INIS		DE93729132	
4990	18:3312	OSTI; NTIS (US Sales Only); INIS		DE93728948	
4991	18:3657	OSTI; NTIS (US Sales Only)		DE93728953	
4999	18:4036	OSTI; NTIS (US Sales Only); INIS		DE93728905	
5001	18:4806	OSTI; NTIS (US Sales Only)		DE93728985	
5008	18:4694	OSTI; NTIS (US Sales Only); INIS		DE93742165	
5022	18:3633	OSTI; NTIS (US Sales Only); INIS		DE93742160	
5030	18:3496	OSTI; NTIS (US Sales Only); INIS		DE93728984	
5034	18:3566	OSTI; NTIS (US Sales Only); INIS		DE93742162	
5045	18:4750	OSTI; NTIS (US Sales Only); INIS		DE93729064	
5052	18:3916	OSTI; NTIS (US Sales Only); INIS		DE93728944	
5059	18:4751	OSTI; NTIS (US Sales Only); INIS		DE93729165	
5063	18:4635	OSTI; NTIS (US Sales Only); INIS		DE93729015	
KFK-PEF–					
80-Vol.1	18:4387	OSTI; NTIS (US Sales Only)		DE93729025	
92	18:4136	OSTI; NTIS (US Sales Only)		DE93728957	
93	18:4201	OSTI; NTIS (US Sales Only)		DE93728952	
KFK-PUG–					
4	18:4411	OSTI; NTIS (US Sales Only)		DE93728909	
KIYaI–					
91-1	18:4590	OSTI; NTIS (US Sales Only); INIS		DE93608435	
91-4	18:4591	OSTI; NTIS (US Sales Only); INIS		DE93608414	
91-6	18:3979	OSTI; NTIS (US Sales Only); INIS		DE93607611	
91-8	18:2915	OSTI; NTIS (US Sales Only); INIS		DE93606694	
91-9	18:3597	OSTI; NTIS (US Sales Only); INIS		DE93606752	
91-10	18:4002	OSTI; NTIS (US Sales Only); INIS		DE93607623	
91-11	18:3980	OSTI; NTIS (US Sales Only); INIS		DE93607610	
KNFC/TR–					
001/92.	18:3065	*See* KAERI/TR–240/91			
LA–					
11990-C	18:4807	OSTI; NTIS; GPO Dep.	E 1.99:	DE92040949	MF-905
12195-MS	18:4202	OSTI; NTIS; GPO Dep.	E 1.99:	DE93001895	PC-903
12246	18:3770	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93002158	MF-731; MF-701
12340-MS	18:3562	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93001429	MF-706
12380-T	18:4572	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93002178	MF-411
12386-M	18:2849	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93003340	MF-714
12389-MS	18:4059	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93001892	
12397-T	18:3598	OSTI; NTIS; GPO Dep.	E 1.99:	DE93001902	MF-704
12414-MS	18:2761	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93001616	MF-830
12415	18:3917	OSTI; NTIS; GPO Dep.	E 1.99:	DE93002856	PC-714
12426-MS	18:3771	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93000827	MF-700
12434-MS	18:4076	OSTI; NTIS; GPO Dep.	E 1.99:	DE93000499	MF-706; MF-741
12435-MS	18:3950	OSTI; NTIS; GPO Dep.	E 1.99:	DE93001860	MF-741
12451-MS	18:4037	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93001907	MF-700
LA-SUB–					
92-11	18:3955	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93001275	
LA-UR–					
92-1624	18:3030	OSTI; NTIS; GPO Dep.	E 1.99:	DE92015242	MF-528
92-1850	18:4278	OSTI; NTIS; GPO Dep.	E 1.99:	DE92017501	MF-400
92-1909	18:4276	OSTI; NTIS; GPO Dep.	E 1.99:	DE92017525	MF-408
92-2511	18:4808	OSTI; NTIS; GPO Dep.	E 1.99:	DE92040393	MF-905
92-2701	18:3599	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE92040243	MF-401
92-2720	18:4003	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93000791	MF-414; MF-406
92-2913	18:4683	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93000792	MF-700
92-2914	18:3665	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93000800	MF-902
92-2915	18:4063	OSTI; NTIS; GPO Dep.	E 1.99:	DE93000799	MF-910
92-2972	18:4809	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93000687	MF-905; MF-910

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92-3030	18:4137	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93000678	MF-402
92-3049	18:4460	OSTI; NTIS; GPO Dep.	E 1.99:	DE93000656	MF-700
92-3054	18:3634	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93000655	
92-3057	18:4695	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93000653	MF-406
92-3073	18:4508	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93000859	MF-910
92-3079	18:4461	OSTI; NTIS; GPO Dep.	E 1.99:	DE93000856	MF-700
92-3132	18:4462	OSTI; NTIS; GPO Dep.	E 1.99:	DE93000852	MF-906
92-3144	18:4463	OSTI; NTIS; GPO Dep.	E 1.99:	DE93000851	MF-700
92-3170	18:4138	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93000860	MF-702
92-3189	18:4592	OSTI; NTIS; GPO Dep.	E 1.99:	DE93000869	MF-412
92-3200	18:4810	OSTI; NTIS; GPO Dep.	E 1.99:	DE93000864	MF-410; MF-405
92-3214	18:4811	OSTI; NTIS; GPO Dep.	E 1.99:	DE93000861	ND-905
92-3227	18:3951	OSTI; NTIS; GPO Dep.	E 1.99:	DE93000874	MF-706; MF-741
92-3445	18:4277	OSTI; NTIS; GPO Dep.	E 1.99:	DE93004632	
92-684	18:3658	OSTI; NTIS; GPO Dep.	E 1.99:	DE92010080	MF-904
92-848	18:3029	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE92011366	MF-528
LBL–					
32021	18:4203	OSTI; NTIS; GPO Dep.	E 1.99:	DE92041172	MF-402
32101	18:4449	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93002627	MF-414
32129	18:3772	OSTI; NTIS; GPO Dep.	E 1.99:	DE92041176	MF-404
32140	18:2944	OSTI; NTIS; GPO Dep.	E 1.99:	DE93000631	
32150	18:4696	OSTI; NTIS; GPO Dep.	E 1.99:	DE93002564	MF-404
32213	18:4752	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93000345	MF-414
32417	18:3822	OSTI; NTIS; GPO Dep.	E 1.99:	DE93001863	MF-330
32436	18:4464	OSTI; NTIS; GPO Dep.	E 1.99:	DE93000587	MF-412
32440	18:4668	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE92041194	MF-401; MF-411
32470	18:3659	OSTI; NTIS; GPO Dep.	E 1.99:	DE92041199	MF-404
32485	18:4573	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93002560	MF-414
32488	18:4286	OSTI; NTIS; GPO Dep.	E 1.99:	DE92041215	MF-405; MF-408
32560	18:4004	OSTI; NTIS; GPO Dep.	E 1.99:	DE93000566	MF-406
32636	18:4424	OSTI; NTIS; GPO Dep.	E 1.99:	DE93000637	MF-350
32639	18:3529	OSTI; NTIS; GPO Dep.	E 1.99:	DE93000633	MF-350
32660	18:4697	OSTI; NTIS; GPO Dep.	E 1.99:	DE93002561	MF-404
32665	18:4139	OSTI; NTIS; GPO Dep.	E 1.99:	DE93001599	
32695	18:4465	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93002559	MF-414
32714	18:4675	OSTI; NTIS; GPO Dep.	E 1.99:	DE93000567	MF-404
32737	18:3810	OSTI; NTIS; GPO Dep.	E 1.99:	DE93002552	MF-401
32790	18:4005	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93002567	MF-414
32829	18:3600	OSTI; NTIS; GPO Dep.	E 1.99:	DE93002548	MF-404
32830	18:3601	OSTI; NTIS; GPO Dep.	E 1.99:	DE93002549	MF-404
32841	18:3811	OSTI; NTIS; GPO Dep.	E 1.99:	DE93002550	MF-401
32853	18:3812	OSTI; NTIS; GPO Dep.	E 1.99:	DE93002557	MF-404
32861	18:4557	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93002573	MF-414
32892	18:3813	OSTI; NTIS; GPO Dep.	E 1.99:	DE93002551	MF-401
32970	18:3975	*See* SLAC-PUB–5948			
LBL-PUB–					
5348	18:4287	OSTI; NTIS; GPO Dep.	E 1.99:	DE92041202	MF-400
LIU-TEK-LIC–					
1992-09	18:3918	OSTI; NTIS; INIS		DE93607603	
LMU–					
10/92.	18:4516	*See* IC–92/216			
LRAP–					
129.	18:4671	*See* LUTFD2-TFAF–1020-1-66-1992			
LU-TP–					
92-21	18:4537	*See* DESY–92-098			
LUMEDW-MERI–					
1027-1-34-1992.	18:4288	*See* LUNFD6-NFRA–1027-1-34-1992			
LUND-MPH–					
92-01	18:4593	OSTI; NTIS; INIS		DE93608436	
LUNFD6-NFRA–					
1027-1-34-1992	18:4288	OSTI; NTIS; INIS		DE93607495	
LUTFD2-TFAF–					
1020-1-66-1992	18:4671	OSTI; NTIS; INIS		DE93608541	
LUTFD2-TFRT–					
5439-1-127-1991	18:3079	OSTI; NTIS; INIS		DE93607685	
5440-1-100-1991	18:4812	OSTI; NTIS; INIS		DE93608127	

Report Number	Abstract Number	Source of Availability	GPO Dep.	Order Number	Distribution Category
MAFF-FRDR–					
27	18:3474	OSTI; NTIS (US Sales Only); INIS		DE93607329	
MLM–					
3764(OP)	18:4064	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93001969	MF-742
3765(OP)	18:4065	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93001970	MF-701
3768	18:3773	OSTI; NTIS; GPO Dep.	E 1.99:	DE93004027	PC-701
MPI-Ph–					
91-113	18:4531	*See* DESY–92-078			
NCAR/TN–					
353	18:4807	*See* LA–11990-C			
NDRL–					
3540	18:3888	*See* DOE/ER/00038–3540			
NEANDC(E)–					
332-U-Vol.3-EURATOM	18:4604	OSTI; NTIS (US Sales Only)		DE93003137	
NESC–					
360	18:4793	*See* ESTSC–000541C660000			
553	18:4795	*See* ESTSC–000543I036000			
585	18:4794	*See* ESTSC–000542H600000			
686	18:4791	*See* ESTSC–000539I036000			
913	18:4796	*See* ESTSC–000544C760000			
913	18:4797	*See* ESTSC–000544I037000			
9574	18:4792	*See* ESTSC–000540CY00100			
960	18:4790	*See* ESTSC–000538I036000			
NIPER–					
633	18:2604	OSTI; NTIS; GPO Dep.	E 1.99:	DE93001396	MF-122; MF-125
639	18:2600	OSTI; NTIS; GPO Dep.	E 1.99:	DE93000903	MF-122; MF-125
NKS–					
92-1	18:3313	OSTI; NTIS; INIS		DE93607341	
NMP-RMT–					
910319-Rev.1	18:2820	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93000475	MF-702
NREL/TP–					
262-4678	18:3556	OSTI; NTIS; GPO Dep.	E 1.99:	DE92016431	MF-331
262-4680	18:3475	OSTI; NTIS; GPO Dep.	E 1.99:	DE92016432	MF-331
411-5018	18:2916	OSTI; NTIS; GPO Dep.	E 1.99:	DE93000026	MF-270
411-5019	18:2917	OSTI; NTIS; GPO Dep.	E 1.99:	DE93000027	MF-270
411-5063	18:2918	OSTI; NTIS; GPO Dep.	E 1.99:	DE93000011	MF-271
411-5123	18:2919	OSTI; NTIS; GPO Dep.	E 1.99:	DE93000023	MF-271
412-5160	18:2920	OSTI; NTIS; GPO Dep.	E 1.99:	DE93000030	MF-270
413-5010	18:2921	OSTI; NTIS; GPO Dep.	E 1.99:	DE92016438	MF-273
413-5012	18:2922	OSTI; NTIS; GPO Dep.	E 1.99:	DE92016439	MF-273
431-4982	18:3552	OSTI; NTIS; GPO Dep.	E 1.99:	DE92016406	MF-249
442-5159	18:2954	OSTI; NTIS; GPO Dep.	E 1.99:	DE93000016	MF-261
463-4951	18:3476	OSTI; NTIS; GPO Dep.	E 1.99:	DE92016443	MF-331
463-5118	18:2910	OSTI; NTIS; GPO Dep.	E 1.99:	DE93000018	MF-233; MF-234
NRFRC-EC–					
1007	18:4238	*See* DOE/PN/38014–T1			
NSF-ITP–					
92-04	18:4455	*See* DOE/ER/40682–20			
92-06	18:4489	*See* DOE/ER/40682–19			
92-101	18:4488	*See* DOE/ER/40682–10			
NSS-R–					
176	18:2821	OSTI; NTIS (US Sales Only); INIS		DE93607966	
177	18:2762	OSTI; NTIS (US Sales Only); INIS		DE93607967	
213	18:4204	OSTI; NTIS (US Sales Only); INIS		DE93607105	
259	18:2763	OSTI; NTIS (US Sales Only); INIS		DE93607968	
269	18:4205	OSTI; NTIS (US Sales Only); INIS		DE93607106	
280	18:3602	OSTI; NTIS (US Sales Only); INIS		DE93606739	
NUCLEBRAS-IPR–					
385	18:3010	OSTI; NTIS (US Sales Only); INIS		DE93607765	
NUREG–					
0750-Vol.35-Index2	18:3035	OSTI; NTIS; INIS; GPO		TI93001982	
0797-Suppl.25	18:3314	OSTI; NTIS; INIS; GPO		TI93002092	
1275-Vol.7	18:3011	OSTI; NTIS; INIS; GPO		TI93002815	
1377-Rev.3	18:3050	OSTI; NTIS; INIS; GPO		TI93001388	
1430-Vol.1	18:3012	OSTI; NTIS; INIS; GPO		TI93002201	
1431-Vol.1	18:3013	OSTI; NTIS; INIS; GPO		TI93002727	
1432-Vol.2	18:3014	OSTI; NTIS; INIS; GPO		TI93003057	

Report Number	Abstract Number	Source of Availability	GPO Dep.	Order Number	Distribution Category
1432-Vol.3	18:3015	OSTI; NTIS; INIS; GPO		TI93003058	
1433-Vol.1	18:2986	OSTI; NTIS; INIS; GPO		TI93002532	
1433-Vol.2	18:2987	OSTI; NTIS; INIS; GPO		TI93002533	
1434-Vol.3	18:2988	OSTI; NTIS; INIS; GPO		TI93003061	
NUREG/CR–					
4674-Vol.16	18:3432	OSTI; NTIS; INIS; GPO		TI93000831	
5305-Vol.3	18:3433	OSTI; NTIS; INIS; GPO		TI93002331	
5443	18:3434	OSTI; NTIS; INIS; GPO		TI93001868	
5512-Vol.1	18:4361	OSTI; NTIS; INIS; GPO		TI93001796	
5826	18:3435	OSTI; NTIS; INIS; GPO		TI93002809	
5828	18:3016	OSTI; NTIS; INIS; GPO		TI93001865	
5837	18:3436	OSTI; NTIS; INIS; GPO		TI93001864	
5838	18:3017	OSTI; NTIS; INIS; GPO		TI93001867	
5868	18:4038	OSTI; NTIS; INIS; GPO		TI93001392	
5912	18:3437	OSTI; NTIS; INIS; GPO		TI93002055	
5913-Vol.1	18:3051	OSTI; NTIS; INIS; GPO		TI93002199	
5925-Vol.2	18:3438	OSTI; NTIS; INIS; GPO		TI93002316	
NUREG/GR–					
0001	18:3603	OSTI; NTIS; INIS; GPO		TI93001983	
NUREG/IA–					
0089	18:3439	OSTI; NTIS; INIS; GPO		TI93002317	
NYSERDA–					
93001449	18:3499	OSTI; New York State Energy Research and Development Authority, Two Rockefeller Plaza, Albany, NY 12223; INIS		TI93001449	
ORNL–					
6605	18:2843	OSTI; NTIS; GPO Dep.	E 1.99:	DE93000494	MF-407
6718	18:2594	OSTI; NTIS; GPO Dep.	E 1.99:	DE93002621	MF-122; MF-123; MF-125; MF-126;
6719	18:2553	OSTI; NTIS; GPO Dep.	E 1.99:	DE93002624	MF-122; MF-123; MF-124; MF-126;
6722	18:3567	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93003665	PC-404
ORNL/CON–					
335	18:3534	OSTI; NTIS; GPO Dep.	E 1.99:	DE93003670	MF-330
351	18:3530	OSTI; NTIS; GPO Dep.	E 1.99:	DE93004029	MF-350
ORNL/ER–					
124	18:4206	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93000588	MF-902
136	18:2765	OSTI; NTIS; GPO Dep.	E 1.99:	DE92041014	MF-902
137	18:2766	OSTI; NTIS; GPO Dep.	E 1.99:	DE93000547	MF-902
154	18:2767	OSTI; NTIS; GPO Dep.	E 1.99:	DE93000548	MF-902
58-D2	18:2830	*See* DOE/OR–1070-D2			
84	18:2764	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93000553	MF-902
ORNL/ER/Sub–					
90-LJ068/1	18:2768	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE92041218	MF-902
ORNL/M–					
1792	18:2769	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93003064	MF-902
2259	18:3080	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93002858	MF-413
2309	18:3635	OSTI; NTIS; GPO Dep.	E 1.99:	DE93003663	PC-332
2347/V2-Pt.3	18:2977	OSTI; NTIS; GPO Dep.	E 1.99:	DE93003680	MF-902
2380	18:4251	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93001401	MF-902
2490	18:4772	OSTI; NTIS; GPO Dep.	E 1.99:	DE93003888	MF-400
ORNL/NOAC–					
232-Vol.16	18:3432	*See* NUREG/CR–4674-Vol.16			
ORNL/RSIC–					
55	18:4645	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93003288	MF-706
ORNL/Sub–					
89-SE500/1	18:3553	OSTI; NTIS; GPO Dep.	E 1.99:	DE93003628	MF-332
ORNL/TM–					
11952	18:2822	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93002227	MF-511
12010	18:4289	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93003669	MF-408
12036	18:2770	OSTI; NTIS; GPO Dep.	E 1.99:	DE93002410	MF-902
12087	18:2572	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93002356	MF-407
12133	18:3636	OSTI; NTIS; GPO Dep.	E 1.99:	DE93003684	MF-332
12145	18:4763	OSTI; NTIS; GPO Dep.	E 1.99:	DE93003660	PC-400
12156/V1	18:3051	*See* NUREG/CR–5913-Vol.1			

Report Number	Abstract Number	Source of Availability	GPO Dep.	Order Number	Distribution Category
ORNL/TM–					
12167	18:4813	OSTI; NTIS; GPO Dep.	E 1.99:	DE93003674	MF-405
12182	18:3500	OSTI; NTIS; GPO Dep.	E 1.99:	DE93003675	MF-220
12230	18:3441	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93004028	
12255	18:4362	OSTI; NTIS; GPO Dep.	E 1.99:	DE93003264	
7448	18:3440	OSTI; NTIS; GPO Dep.	E 1.99:	DE93003070	MF-523
PATENTS-US–					
A7641391	18:3919	OSTI; NTIS; GPO Dep.	E 1.99:	DE93001988	MF-706
A7643318	18:2967	OSTI; NTIS; GPO Dep.	E 1.99:	DE93001989	MF-406
A7647074	18:4290	OSTI; NTIS; GPO Dep.	E 1.99:	DE93001990	MF-406
A7647075	18:3956	OSTI; NTIS; GPO Dep.	E 1.99:	DE93001991	MF-706
A7647963	18:3052	OSTI; NTIS; GPO Dep.	E 1.99:	DE93001992	MF-506
A7648931	18:3053	OSTI; NTIS; GPO Dep.	E 1.99:	DE93001993	MF-506
A7650264	18:3957	OSTI; NTIS; GPO Dep.	E 1.99:	DE93001994	MF-706
A7651864	18:3814	OSTI; NTIS; GPO Dep.	E 1.99:	DE93001995	MF-401
A7652737	18:3958	OSTI; NTIS; GPO Dep.	E 1.99:	DE93001996	MF-704
A7653543	18:2923	OSTI; NTIS; GPO Dep.	E 1.99:	DE93001997	MF-270
A7654457	18:3959	OSTI; NTIS; GPO Dep.	E 1.99:	DE93001998	MF-704
A7654460	18:4055	OSTI; NTIS; GPO Dep.	E 1.99:	DE93001999	MF-506
A7656325	18:3960	OSTI; NTIS; GPO Dep.	E 1.99:	DE93002000	MF-706
A7656329	18:3520	OSTI; NTIS; GPO Dep.	E 1.99:	DE93002001	MF-706
A7660503	18:4814	OSTI; NTIS; GPO Dep.	E 1.99:	DE93002002	MF-705
A7663348	18:2595	OSTI; NTIS; GPO Dep.	E 1.99:	DE93002003	MF-103
A7663351	18:3961	OSTI; NTIS; GPO Dep.	E 1.99:	DE93002004	MF-706
A7663486	18:3920	OSTI; NTIS; GPO Dep.	E 1.99:	DE93002005	MF-704
A7663496	18:4291	OSTI; NTIS; GPO Dep.	E 1.99:	DE93002006	MF-706
A7663518	18:4051	OSTI; NTIS; GPO Dep.	E 1.99:	DE93002008	MF-706
A7663519	18:4049	OSTI; NTIS; GPO Dep.	E 1.99:	DE93002009	MF-506
A7663520	18:2978	OSTI; NTIS; GPO Dep.	E 1.99:	DE93002010	MF-106
A7664700	18:3962	OSTI; NTIS; GPO Dep.	E 1.99:	DE93002011	MF-706
A7664717	18:3054	OSTI; NTIS; GPO Dep.	E 1.99:	DE93002012	MF-706
A7664728	18:3637	OSTI; NTIS; GPO Dep.	E 1.99:	DE93002013	MF-706
A7664915	18:3963	OSTI; NTIS; GPO Dep.	E 1.99:	DE93002014	MF-706
A7665066	18:4052	OSTI; NTIS; GPO Dep.	E 1.99:	DE93002015	MF-706
A7665112	18:4045	OSTI; NTIS; GPO Dep.	E 1.99:	DE93002016	MF-506
A7665209	18:2694	OSTI; NTIS; GPO Dep.	E 1.99:	DE93002017	MF-406
A7665520	18:3921	OSTI; NTIS; GPO Dep.	E 1.99:	DE93002018	MF-706
A7665640	18:3823	OSTI; NTIS; GPO Dep.	E 1.99:	DE93002019	MF-706; MF-701
A7665854	18:3638	OSTI; NTIS; GPO Dep.	E 1.99:	DE93002020	MF-404
A7666970	18:3922	OSTI; NTIS; GPO Dep.	E 1.99:	DE93002021	MF-706
A7666971	18:3604	OSTI; NTIS; GPO Dep.	E 1.99:	DE93002022	MF-704
A7668521	18:2554	OSTI; NTIS; GPO Dep.	E 1.99:	DE93002023	MF-105
A7668522	18:3450	OSTI; NTIS; GPO Dep.	E 1.99:	DE93002024	MF-350
A7668849	18:2924	OSTI; NTIS; GPO Dep.	E 1.99:	DE93002027	MF-231
A7669718	18:3660	OSTI; NTIS; GPO Dep.	E 1.99:	DE93002028	MF-231
A7670111	18:3639	OSTI; NTIS; GPO Dep.	E 1.99:	DE93002025	MF-706
A7670112	18:2911	OSTI; NTIS; GPO Dep.	E 1.99:	DE93002026	MF-234
A7671230	18:3964	OSTI; NTIS; GPO Dep.	E 1.99:	DE93002029	MF-366
A7671231	18:4698	OSTI; NTIS; GPO Dep.	E 1.99:	DE93002030	MF-704
A7671237	18:4006	OSTI; NTIS; GPO Dep.	E 1.99:	DE93002031	MF-706
A7672277	18:4066	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93002032	MF-742
PECD–					
7-9-356	18:3651	*See* DOE-HMIP-RR–92-027			
7-9-367.	18:4184	*See* DOE-RW–89-091			
7-9-561	18:3650	*See* DOE-HMIP-RR–92-026			
PNL–					
7654	18:3435	*See* NUREG/CR–5826			
7727	18:3016	*See* NUREG/CR–5828			
7923	18:3436	*See* NUREG/CR–5837			
7924	18:3017	*See* NUREG/CR–5838			
7994-Vol.1	18:4361	*See* NUREG/CR–5512-Vol.1			
8149	18:4140	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93003339	MF-602
8290	18:3502	OSTI; NTIS; GPO Dep.	E 1.99:	DE93003139	MF-202
8296	18:3545	OSTI; NTIS; GPO Dep.	E 1.99:	DE93001662	MF-313
8300	18:4207	OSTI; NTIS; GPO Dep.	E 1.99:	DE92041319	
8302-Vol.1	18:4425	OSTI; NTIS; GPO Dep.	E 1.99:	DE92041335	
8302-Vol.2	18:4426	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE92041139	
8352	18:4053	OSTI; NTIS; GPO Dep.	E 1.99:	DE93002976	
8360	18:4363	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93003286	MF-602
8361	18:2844	OSTI; NTIS; GPO Dep.	E 1.99:	DE93002511	MF-600
8372	18:3973	OSTI; NTIS; GPO Dep.	E 1.99:	DE93002954	MF-607

Report Number	Abstract Number	Source of Availability	GPO Dep.	Order Number	Distribution Category
8373	18:3923	OSTI; NTIS; GPO Dep.	E 1.99:	DE93002973	MF-600
8374	18:2845	OSTI; NTIS; GPO Dep.	E 1.99:	DE93002975	MF-607
8385	18:4433	OSTI; NTIS; GPO Dep.	E 1.99:	DE93002974	MF-900
PNL-SA–					
20301	18:3546	OSTI; NTIS; GPO Dep.	E 1.99:	DE93001548	
20309	18:3547	OSTI; NTIS; GPO Dep.	E 1.99:	DE93001506	MF-500
20388	18:3451	OSTI; NTIS; GPO Dep.	E 1.99:	DE93001551	MF-202
20524	18:3031	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93001512	MF-528
20623	18:2846	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93001380	MF-902
20710	18:2771	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93001310	MF-940
20711	18:4141	OSTI; NTIS; GPO Dep.	E 1.99:	DE93001558	MF-402
20744	18:3548	OSTI; NTIS; GPO Dep.	E 1.99:	DE93001549	
20750	18:4208	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93001306	MF-502
20872	18:4753	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93001560	MF-423
20881	18:4764	OSTI; NTIS; GPO Dep.	E 1.99:	DE92041331	MF-900
20885	18:3640	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93001514	MF-411
20898	18:4142	OSTI; NTIS; GPO Dep.	E 1.99:	DE93001557	MF-402
20899	18:4143	OSTI; NTIS; GPO Dep.	E 1.99:	DE93001554	MF-402
20912	18:2772	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE92041340	MF-902
20978	18:2823	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93001308	MF-940
21073	18:3452	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93001300	MF-252
21094	18:3531	OSTI; NTIS; GPO Dep.	E 1.99:	DE93001550	MF-920
21119	18:3815	OSTI; NTIS; GPO Dep.	E 1.99:	DE93001565	MF-401
21163	18:4252	OSTI; NTIS; GPO Dep.	E 1.99:	DE93001517	MF-402
21181	18:2947	OSTI; NTIS; GPO Dep.	E 1.99:	DE93001559	MF-402
21186	18:4815	OSTI; NTIS; GPO Dep.	E 1.99:	DE93001513	MF-905
21215	18:2773	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93001307	MF-940
21231	18:4144	OSTI; NTIS; GPO Dep.	E 1.99:	DE93001515	MF-402
21259	18:3774	OSTI; NTIS; GPO Dep.	E 1.99:	DE93001511	MF-401
21348	18:3483	OSTI; NTIS; GPO Dep.	E 1.99:	DE93001553	MF-900
PNWD–					
2020-HEDR	18:4364	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93001345	MF-707
2021-HEDR	18:4365	OSTI; NTIS; GPO Dep.	E 1.99:	DE93001494	
2022-HEDR	18:4366	OSTI; NTIS; GPO Dep.	E 1.99:	DE93001493	MF-707
2023-HEDR	18:4367	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93000840	MF-707
2024-HEDR	18:4368	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93001492	MF-707
2033-HEDR-Vol.1	18:4369	OSTI; NTIS; GPO Dep.	E 1.99:	DE93002040	
2033-HEDR-Vol.2	18:4370	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93002041	
POEF–					
3010	18:2774	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93001859	MF-510
PPPL–					
2855	18:4727	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93003289	PC-420; PC-421; PC-422; PC-423;
2856	18:4728	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93002633	PC-420; PC-421; PC-427
PPPL-CFP–					
2755	18:4729	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93002101	MF-426
2756	18:4730	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93002102	MF-421
2757	18:4731	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93002103	MF-420
2758	18:4732	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93002100	MF-420
PRE–					
1680.	18:4718	*See* INPE–5256			
1681.	18:4719	*See* INPE–5257			
1746.	18:3630	*See* INPE–5372			
1750.	18:4720	*See* INPE–5384			
PRL-TH–					
92/16.	18:4568	*See* IC–92/199			
PRP–					
158.	18:4717	*See* INPE–5255			
169.	18:4721	*See* INPE–5403			
PSI–					
Bericht-Nr.91	18:3439	*See* NUREG/IA–0089			
PTB-Ra–					
30	18:4145	OSTI; NTIS (US Sales Only); INIS		DE93728836	
PWA–					
39/91	18:4036	*See* KFK–4999			

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Q–					
141	18:3888	*See* DOE/ER/00038–3540			
QR–					
7020-3	18:2972	*See* DOE/PC/88943–T4			
7020-4	18:2973	*See* DOE/PC/88943–T5			
RAL–					
92-034	18:4652	OSTI; NTIS (US Sales Only); INIS		DE93608516	
92-039	18:4574	OSTI; NTIS (US Sales Only); INIS		DE93608387	
RFP–					
4502	18:4427	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93003116	MF-707
RISLEY-Trans–					
5923	18:3442	OSTI; NTIS (US Sales Only)		DE93000501	
RTR–					
1070	18:3102	*See* DPSP–69-1172-Del.Ver.			
RU–					
92/16/B	18:4470	*See* DOE/ER/40651–2			
92/E-36	18:4546	*See* DOE/ER/40651–3			
SAIC–					
92/1230	18:4754	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93004604	MF-427
92/6668-R1-Vol.2	18:3438	*See* NUREG/CR–5925-Vol.2			
SAND–					
88-2958-Rev.	18:4060	OSTI; NTIS; GPO Dep.	E 1.99:	DE93004025	MF-905
90-0087	18:3434	*See* NUREG/CR–5443			
90-0511	18:3903	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93003231	MF-742
90-2765-Vol.3	18:3433	*See* NUREG/CR–5305-Vol.3			
91-2600C	18:2716	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93000711	MF-940
91-2627C	18:2717	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE92041159	MF-902
91-2630C	18:3924	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE92041157	MF-900
91-2682C	18:3925	OSTI; NTIS; GPO Dep.	E 1.99:	DE93000759	MF-902
91-2691C	18:2718	OSTI; NTIS; GPO Dep.	E 1.99:	DE93000760	MF-900
91-2901C	18:3641	OSTI; NTIS; GPO Dep.	E 1.99:	DE92008523	MF-704
91-7038	18:2775	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93002513	MF-814
92-0175C	18:3661	OSTI; NTIS; GPO Dep.	E 1.99:	DE92008675	MF-404
92-0263C	18:3816	OSTI; NTIS; GPO Dep.	E 1.99:	DE93002278	MF-241
92-0452	18:4077	OSTI; NTIS; GPO Dep.	E 1.99:	DE93004026	MF-706; MF-705
92-0667C	18:4061	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93002307	
92-0837	18:4078	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93003234	MF-706
92-0866C	18:4450	OSTI; NTIS; GPO Dep.	E 1.99:	DE93000740	MF-705
92-0978C	18:3443	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93002463	
92-1061C	18:2955	OSTI; NTIS; GPO Dep.	E 1.99:	DE93002478	MF-261
92-1063C	18:4816	OSTI; NTIS; GPO Dep.	E 1.99:	DE93002472	MF-706
92-1201C	18:3926	OSTI; NTIS; GPO Dep.	E 1.99:	DE93000753	MF-706
92-1207C	18:3032	OSTI; NTIS; GPO Dep.	E 1.99:	DE92018823	
92-1261C	18:3444	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93002464	
92-1407C	18:3033	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE92040974	MF-528
92-1607C	18:2956	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93002459	MF-261
92-1611	18:3453	OSTI; NTIS; GPO Dep.	E 1.99:	DE93003224	MF-212
92-1658	18:3454	OSTI; NTIS; GPO Dep.	E 1.99:	DE93004001	MF-706
92-1722C	18:3927	OSTI; NTIS; GPO Dep.	E 1.99:	DE93002487	MF-700
92-1744C	18:3081	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE92040271	MF-706
92-1841	18:4007	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93004022	MF-427
92-1859C	18:3928	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE92040958	MF-722
92-1904	18:2943	OSTI; NTIS; GPO Dep.	E 1.99:	DE93004023	MF-272
92-1913C	18:4699	OSTI; NTIS; GPO Dep.	E 1.99:	DE93000756	MF-706
92-1919C	18:3965	OSTI; NTIS; GPO Dep.	E 1.99:	DE92040977	MF-700
92-1938C	18:4451	OSTI; NTIS; GPO Dep.	E 1.99:	DE93000745	MF-700
92-1947	18:2850	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93003225	MF-515
92-1958C	18:3605	OSTI; NTIS; GPO Dep.	E 1.99:	DE93000739	MF-704
92-1996C	18:3945	OSTI; NTIS; GPO Dep.	E 1.99:	DE93002279	MF-406
92-2006C	18:3662	OSTI; NTIS; GPO Dep.	E 1.99:	DE93000714	MF-706
92-2042C	18:2622	OSTI; NTIS; GPO Dep.	E 1.99:	DE93000747	MF-126
92-2083C	18:4466	OSTI; NTIS; GPO Dep.	E 1.99:	DE93002284	MF-706; MF-704
92-2214C	18:3929	OSTI; NTIS; GPO Dep.	E 1.99:	DE93002480	MF-706
92-7281	18:4817	OSTI; NTIS; GPO Dep.	E 1.99:	DE93003228	MF-905
92-7294	18:3663	OSTI; NTIS; GPO Dep.	E 1.99:	DE93003229	MF-276
92-7296	18:4646	OSTI; NTIS; GPO Dep.	E 1.99:	DE93003230	MF-607
92-8625	18:4818	OSTI; NTIS; GPO Dep.	E 1.99:	DE93002670	MF-405
SER/CDM–					
29	18:2656	OSTI; NTIS (US Sales Only); INIS		DE93606680	

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30	18:3817	OSTI; NTIS (US Sales Only); INIS		DE93606586	
SER/LSO-DC–					
50	18:3818	OSTI; NTIS (US Sales Only); INIS		DE93606587	
SINS–					
2087/ZDAJ/PP/B	18:4008	OSTI; NTIS (US Sales Only); INIS		DE93607616	
2088/P-2/PL/A	18:4733	OSTI; NTIS (US Sales Only); INIS		DE93608594	
2093/P-8/PH/B	18:4599	OSTI; NTIS (US Sales Only); INIS		DE93608441	
2103/P-5/PP/A	18:4734	OSTI; NTIS (US Sales Only); INIS		DE93608555	
2104/P-5/PP/A	18:4452	OSTI; NTIS (US Sales Only); INIS		DE93608181	
2111/P-8/PL/B	18:4594	OSTI; NTIS (US Sales Only); INIS		DE93608415	
2120/P-5/PP/A	18:4735	OSTI; NTIS (US Sales Only); INIS		DE93608556	
2121/P-6/PH/A	18:4039	OSTI; NTIS (US Sales Only); INIS		DE93607874	
2122/P-6/PH/A	18:4636	OSTI; NTIS (US Sales Only); INIS		DE93608485	
SISSA–					
141/92/EP	18:4516	*See* IC–92/216			
SITP-NOTE–					
037.	18:4047	*See* UM-P–92/45			
SLAC–					
398	18:4558	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93002490	PC-414
403	18:4009	OSTI; NTIS; GPO Dep.	E 1.99:	DE93002628	PC-406
405	18:3981	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93002517	PC-414
406	18:4509	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93002516	PC-414
SLAC-PUB–					
5827	18:4615	*See* GSI–92-35(prepr.)			
5899	18:4010	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93004088	MF-414
5902	18:4559	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93004089	MF-414
5917	18:4524	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93001822	MF-414
5919	18:4011	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93004090	MF-414
5928	18:3974	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93001824	MF-414
5948	18:3975	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93004091	MF-414
5950	18:4012	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93004016	MF-414
5955	18:3976	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93004018	MF-414
5974	18:4560	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93004092	MF-414
5976	18:4561	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93004093	MF-414
5977	18:4575	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93004021	MF-414
SOL–					
92-6	18:4819	OSTI; NTIS; GPO Dep.	E 1.99:	DE93002660	MF-405
SR/H–					
202	18:3115	*See* DPW–5695			
207	18:3116	*See* DPW–5801			
210	18:3301	*See* DPW–5910			
221	18:3111	*See* DPW–5385			
230	18:3057	*See* DPW–5471			
232	18:3112	*See* DPW–5477			
233	18:3113	*See* DPW–5489			
235	18:3114	*See* DPW–5513			
237	18:3300	*See* DPW–5540			
240	18:3103	*See* DPW–53-7-2			
241	18:3106	*See* DPW–53-7-11			
242	18:3105	*See* DPW–53-7-10			
243	18:3104	*See* DPW–53-7-5			
246	18:2680	*See* DPW–6803			
247	18:3117	*See* DPW–6780			
249	18:3058	*See* DPW–6761			
251	18:3107	*See* DPW–53-639			
252	18:3108	*See* DPW–53-650			
253	18:3291	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93002719	MF-700
254	18:3292	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93002720	MF-700
255	18:2679	*See* DPW–53-652			
256	18:3109	*See* DPW–53-654			
257	18:3110	*See* DPW–53-656			
SR/RNGD–					
92-01	18:2614	OSTI; NTIS; GPO; GPO Dep.	E 1.99:	DE93002217	MF-950
SRA–					
9201	18:4038	*See* NUREG/CR–5868			
SSCL–					
598	18:4040	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93003330	PC-414
602	18:4013	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93004390	PC-414
SSCL-Preprint–					
122	18:3977	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE92015962	MF-414
150	18:3982	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93002046	MF-414

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SSCL-Preprint–					
153	18:4041	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93001674	MF-414
155	18:4042	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93001680	MF-414
8-Rev.A	18:4820	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93003318	MF-400; MF-414
SSI-P–					
569-90	18:2776	OSTI; NTIS; INIS		DE93607969	
STUK-A–					
100	18:4371	OSTI; NTIS; INIS		DE93607201	
STUK-B-YTO–					
97	18:2989	OSTI; NTIS; INIS		DE93607702	
TTC–					
1118	18:2716	*See* SAND–91-2600C			
1142	18:3925	*See* SAND–91-2682C			
1146	18:2718	*See* SAND–91-2691C			
TVA-Bull–					
Z-311	18:3606	OSTI; NTIS		DE93002586	
UCB-PTH–					
92/07	18:4449	*See* LBL–32101			
92/22	18:4573	*See* LBL–32485			
92/25	18:4465	*See* LBL–32695			
UCLA–					
92/TEP/25	18:4488	*See* DOE/ER/40682–10			
UCLA/PPG–					
1323-Vol.1	18:4755	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93002184	MF-420
UCRL-CR–					
111574	18:4821	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93001610	MF-705
111575	18:4822	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93001611	MF-705
111576	18:4823	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93001613	MF-705
UCRL-ID–					
109921	18:2777	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE92041080	MF-814
111866	18:3563	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93001829	MF-700
111966	18:4824	OSTI; NTIS; GPO Dep.	E 1.99:	DE93003337	MF-706
111967	18:3952	OSTI; NTIS; GPO Dep.	E 1.99:	DE93003336	MF-706
112027	18:4209	OSTI; NTIS; GPO Dep.	E 1.99:	DE93003332	MF-703
112038	18:2601	OSTI; NTIS; GPO Dep.	E 1.99:	DE93003335	MF-123
112135	18:4146	OSTI; NTIS; GPO Dep.	E 1.99:	DE93003333	MF-702
UCRL-JC–					
108837	18:3607	OSTI; NTIS; GPO Dep.	E 1.99:	DE93001305	MF-701
109361	18:4825	OSTI; NTIS; GPO Dep.	E 1.99:	DE93001304	MF-705
109621	18:2602	OSTI; NTIS; GPO Dep.	E 1.99:	DE93001316	MF-703
109942	18:4595	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93001321	MF-701
110349	18:4043	OSTI; NTIS; GPO Dep.	E 1.99:	DE93000515	MF-700
110655-Rev.1	18:3819	OSTI; NTIS; GPO Dep.	E 1.99:	DE93001327	MF-401
111211	18:4046	OSTI; NTIS; GPO Dep.	E 1.99:	DE93001621	MF-700
111359	18:3608	OSTI; NTIS; GPO Dep.	E 1.99:	DE93001507	MF-401
111428	18:4826	OSTI; NTIS; GPO Dep.	E 1.99:	DE92040400	MF-705
111447	18:3966	OSTI; NTIS; GPO Dep.	E 1.99:	DE93001620	MF-700
111468	18:4659	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93001617	MF-700
111848	18:4147	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93001508	MF-702
111946	18:4467	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93002892	MF-700
UCRL-LR–					
109207	18:4756	OSTI; NTIS; GPO Dep.	E 1.99:	DE93002854	PC-712
110870	18:2695	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93001623	MF-732
110877	18:4736	OSTI; NTIS; GPO Dep.	E 1.99:	DE92041090	MF-700
110897	18:4576	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93001625	MF-700
110935	18:4757	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93001624	MF-712
111809	18:4827	OSTI; NTIS; GPO Dep.	E 1.99:	DE93001509	MF-705
UM-P–					
92/45	18:4047	OSTI; NTIS (US Sales Only); INIS		DE93607941	
UW-CPTC–					
92-5	18:4737	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93002352	PC-427
VTT-PUB–					
54	18:3055	OSTI; NTIS; INIS		DE93607652	
VTT-SYMP–					
126	18:4210	OSTI; NTIS; INIS		DE93607107	
VTT-TIED–					
1203	18:4048	OSTI; NTIS; INIS		DE93605912	
1326	18:4773	OSTI; NTIS; INIS		DE93608136	
WAESD-TN–					
87-0028	18:2957	OSTI; NTIS; GPO Dep.	E 1.99:	DE93002137	MF-261

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WHC-EP–					
0182-48	18:2785	OSTI; NTIS; GPO Dep.	E 1.99:	DE93001754	MF-940
0182-50	18:2786	OSTI; NTIS; GPO Dep.	E 1.99:	DE93001666	MF-902
0182-51	18:2787	OSTI; NTIS; GPO Dep.	E 1.99:	DE93001755	MF-940
0393-Rev.2-Pt.1	18:2788	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93001452	MF-940
0402-Rev.1	18:2824	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93002053	MF-902
0516	18:2789	OSTI; NTIS; GPO Dep.	E 1.99:	DE93001676	MF-902
0563	18:2790	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93001667	MF-940
0570	18:2791	OSTI; NTIS; GPO Dep.	E 1.99:	DE93001752	MF-902
0573	18:4212	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93001668	MF-902
WHC-SA–					
1430	18:4605	OSTI; NTIS; GPO Dep.	E 1.99:	DE93002049	MF-506
1466	18:2851	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93001424	MF-700
1480	18:4835	OSTI; NTIS; GPO Dep.	E 1.99:	DE93002047	MF-500
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